UNIVERSITY of TASMANIA

Exploring the impact of 1:1 technology on teachers' pedagogy.

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DECLARATION

I certify that this dissertation contains no material that has been accepted for the award of any other degree or diploma in any institute, college or university. In addition, to the best of my knowledge and belief, it contains no material previously published or written by another person, except where due reference is made in the text of the dissertation.

……..…….

Lillian R. Males

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Abstract

The integration of technology, particularly through 1:1 device programs, has increased in schools over the last decade. Therefore, it is important teachers effectively implement computers into the classroom program through utilising functions such as programs, applications and the internet. The aim of this project was to explore the impact of 1:1 technology on teachers' pedagogy. This was completed through identifying pedagogical adaptations teachers made when every student in their class had their own device. To fulfill this aim, three guiding research questions were posed and explored through a grounded theory approach: 1. What is the nature of pedagogical adaptations teachers make when transitioning from technologically less well equipped classes to classes where every student has a personal computer?; 2. Which of these adaptations is most effective?; 3. How are the answers to RQ1 and RQ2 dependent upon the prescribed curriculum and accountability processes?

Source materials including ICT user policy agreements and Behaviour management policies were collected from schools of participant teachers where five interviews were conducted with volunteer teachers who have 1:1 computers in their classroom of interviews conducted in addition to the inclusion of interviews from the Australian section of the EdFutures Study conducted by Professor Peter Twining. School policies. Source materials were analysed through a comparative document analysis against selection criteria and interview transcripts were collated through a grounded theory method.

As a result of analysis the following were identified as the most significant pedagogical adaptations made in 1:1 classrooms: Digital preparation, the role of the digital teacher and 21st century learning. Of these three adaptations, digital preparation was found to be the most effective adaptation teachers could make. In addition, it was determined that these adaptations

relied upon the curriculum and accountability process. The study recommends teachers plan for these environments utilising electronic storage such as Onenote or online learning environments. In this way, digital preparation can be easily shared with colleagues and reused for future lessons. This research also recommended schools explicitly state their vision for technology usage in classrooms, so teachers have a guide for planning and goals to work towards.

Keywords: 1:1 technology, schools, pedagogical adaptations, planning.

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Chapter 1. Introduction

1.1 Overview of Research

Over the last decade, society has become increasingly technology orientated (Finger, Russell, Jamieson-Proctor & Russell, 2007). At the same time there has been a simultaneous integration of technology into Education where students are using desk top computers and in many cases students access their own device (1:1 program) (Buchanan, 2011).

The Digital Education Revolution (DER) implemented by the federal government under the direction of Prime Ministers Kevin Rudd and Julia Gillard sought to provide schools with funding for technology, moving them into the digital age and ensuring all students Years 9-12 had individual access to computers throughout every school day (Australian Institute for Teaching and School Leadership [AITSL], 2008). The DER was a 1.2 billion dollar, five year election commitment to improving education in recognition that technology has the "potential to transform all aspects of school education" (AITSL, 2008, p. 4). The DER's primary objective was to ensure all schools were equipped with the educational tools of the 21st century (Department of Education, Employment & Workplace Relations, 2008). The scheme also highlighted the significance of teachers having the knowledge, skills, confidence, resources, support and pedagogical practices to be able to "harness the benefits of the digital revolution: and effectively implement Information and Communication Technology (ICT) into the classroom" (AITSL, 2008, p.6; Australian Information and Communications Technology in Education Committee [aictec], 2009). The importance of technology is also reflected in the Tasmanian Government's State Budget for 2013-2014 which allocated 26.7% or $1 349.2 million towards education, including money to upgrade schools' technology (Giddings, 2013, p. 1.6).

Since the expiry of the DER, many schools have introduced technology driven schemes including 1:1 programs, sometimes through Bring Your Own Device/Technology (BYOD/BYOT) models as methods of integrating the use of technology into the everyday lives of students while they are at school (Sagani, 2013). BYOD is an IT policy where students are allowed or encouraged to use their personal mobile devices in a school environment where they are allowed access to the schools online networks. This integration of technology has been driven by the need for students in the 21st Century to possess the skills necessary to effectively function in an increasingly technology orientated society (Ministerial Council on Education, Employment, Training & Youth Affairs [MCEETYA], 2008). When studying ICT as a general capability, students learn to use ICT effectively and appropriately to access, create and communicate information and ideas, solve problems and work collaboratively in all learning areas at school, and in their lives beyond school. (Australian Curriculum, Reporting and Assessment Authority [ACARA], 2014, p. 1).

1.2 Personal Justification for Research

Throughout my classroom experiences as a Teacher's Assistant and on Professional Experience it has been evident that many teachers do not use technology to its full capacity as a learning tool. Despite, technological devices are continuously installed into classrooms. From these experiences I have observed that many teachers lack the confidence and/or knowledge to effectively integrate these technological devices into their daily routines of the classroom, whether it be a small number of iPads or an interactive whiteboard, as learning tools. As someone who was born into what can be described as the technology driven or addicted generation, and someone who uses technology daily, the implementation of technology into schools is a logical next step to assist students in developing the 21st century skills needed to effectively operate within society. Therefore, I am in favour of the

reasons behind the push to see technology integrated into the curriculum and classrooms around the world. During my studies at University, particularly within the unit *Digital Technologies*, I have found technology is changing the way we live and learn and this is going to continue to be the case as long as we remain a technology driven society. Recently many schools, particularly those in the Independent and Catholic sector, have implemented programs that involve students having their own computers/tablets on a 1:1 ratio for use in the classroom. Schools in the public sector have also been trialing BYOD or BYOT programs which allow students to utilise devices they own in the classroom. Around the world, schools are trialing these programs with the goal of students developing the 21st Century skills they require to contribute to society after they leave formal education (Finger et al, 2007). As a future teacher I believe it will be vital to have the ability to effectively plan and teach using technology because of the pace at which our society is becoming increasingly technology centred. Therefore, investigating the pedagogical changes that are needed to effectively implement technology in a 1:1 environment will be highly relevant to myself as a graduate teacher, to teachers who are already within this situation and need guidance, and for schools who are considering implementing a 1:1 technology based learning environment.

1.3 Social Justification for Research

This project is of practical significance to 21st century teachers as technological devices are increasingly being infused within the teaching and learning environment of schools (Keane, Lang & Pilgrim, 2012; Redmond, 2011). As suggested by Fariman (2004), Lowther, Strahl, Zoblotsky as well as Huang (2008) and Peck, Clausen, Vilberg, Meidl and Murray (2008) research conducted in this area has concluded that within a 1:1 technology based learning environment, the teacher takes on more of a facilitator role, where learning becoming more student centred (as cited in Corn, Tagsold and Patel, 2011;

Pally, 2013). However, what is not understood is how the facilitator role changes within the 1:1 classroom. Studies are needed to understand how 1:1 provision affects teachers' planning and the strategies to ensure students are engaged in their learning (Corn, Tagsold & Patell, 2011; Dunleavy, Dexter & Heinecket, 2007; Keane, Lang & Pilgrim, 2012). As discussed by Kukulska-Hulme and Traxler (2007), 1:1 technological environments have greater potential for not only improving teaching and learning, but also for encouraging the use of non-traditional methods of pedagogy, however, the key features of these non-traditional methods are not identified (as cited in Keane, Lang & Pilgrim, 2012).

Students need to be prepared for 21st century society, where everybody requires the skills to share, use and learn with ICT as a general capability (ACARA, 2013). According to Dawes, technology has the ability and potential to support student learning across all learning areas and influence teaching in a positive way (2001, as cited in Bingimlas, 2009). The Melbourne Declaration also highlights the importance of students becoming "creative and productive users of technology" which can be achieved through students' engagement with technology on a 1:1 ratio and its use becoming commonplace within the daily activities and routine of the 21st century classroom (MCEETYA, 2008, p. 9). Students need the "skills, knowledge and confidence" to be able to actively engage and work together with the technology in preparation for life after school, where they have the capability of being able to positively contribute to the community both in present day society and that of the future (ACARA, 2013, p. 49; White, 2013). Furthermore, with the composition of the 21st century classroom changing through the introduction of technology, it is important that teachers are able to immerse students in an environment where they will learn 21st century skills through pedagogy that demonstrates the skills and knowledge required.

1.4 Changes in Pedagogy

The Digital Education Revolution sought to encourage teachers to create more student centred learning programs utilising 21st century learning through the use of technological devices (AITSL, 2008). As a means of achieving this national vision, the DER outlined four strands of change. These strands included a statement that teachers must "have the skills and tools to design and deliver programs that meet students' needs and harness the benefits and resources of the digital revolution" (AITSL, 2008, p. 6). Through adequate professional development opportunities and the cooperation of Universities training future teachers, one of the main underlying principles of the DER was to ensure that teachers possessed sufficient pedagogical knowledge, enough to support the creativity of students and utilise the technology in a way that stimulated and engaged them (aictec, 2009).

The guiding question is proposed:

"How have teachers' pedagogies altered within a 1:1 technology based learning environment?"

Teachers' pedagogy is explored through all facets including the four domains "subject and curriculum knowledge, teaching repertoire of skills and techniques, teaching and learning models and conditions for learning" and "encompasses the theory and practice of supporting other people's learning" and therefore, highlighting the necessary alterations from more traditional methods of pedagogy to teach within a 21st century classroom (Hall, Murphy, & Soler, 2008; Reimann & Goodyear, 2004, p.11 as cited in Finger, Russell, Jamieson-Proctor & Russell, 2007, p. 125). This guiding question will be explored through the approaches to teaching used in relation to the role of the teacher within the classroom, presentation of content, communication with students, behaviour management, student

engagement strategies, assessment and catering for student diversity (Hall, Murphy, & Soler, 2008).

Through answering this guiding question the project will assist future and existing teachers to most effectively utilise and integrate 1:1 technology within the classroom learning environment. This will be done through highlighting the specific pedagogical styles used by teachers already operating within these settings and drawing out common themes to inform future practice.

1.5 Conclusion

For teachers to ensure that students are equipped with the skills and knowledge they require to contribute to 21st century society, teachers need to be practicing 21st century pedagogy where the teacher is not the primary source for information through the utilisation of technology within the classroom environment. This is outlined in the Melbourne Declaration on Educational Goals for Young Australians (MCEETYA, 2008) and throughout the Australian Curriculum, (ACARA, 2014). The DER also emphasises that teachers are required to be confident and skillful users of ICT, because of its potential to benefit student learning (AITSL, 2008). Therefore, through the completion of this research project, pedagogical traits will be identified to assist teachers in the development of 21st century pedagogy, where they must operate within a classroom where each student is accessing their own computer or device.

Chapter two illustrates the key ideas of research in this field and highlights the gap in literature in regards to pedagogy in 1:1 technology based learning environments.

Chapter 2. Literature Review

2.1 Introduction

Teacher pedagogy is central to classroom learning and to this study. However, pedagogy operates within a global context, and increasingly classrooms are being infiltrated by computers. Therefore, this literature review starts by outlining the global context for computers in education. It then moves on to the literature concerning the worldwide adoption of 1:1 programs and the resulting pedagogical adaptations teachers make. The focus then moves to the role of the teacher and the effectiveness of learning with computers.

2.2 The global context for computers in education

> *"The use of ICT in the classroom is very important for providing opportunities for students to learn to operate in an information age' (Bingimlas, 2009, p.235)."*

Bingimlas' perspective was reflected in the UNESCO (2002) description which highlights the challenges educational systems and teachers will face in transforming teaching and learning. This transformation ensures students are equipped with the skills required to function effectively within a continuously changing, technology rich society (as cited in Finger, Russell, Jameson-Proctor & Russell, 2007, p.34; Bate, MacNish & Males, 2012). There is a strong growing interest in the area of 1:1 technology based learning environments in schools (Keane, Lang & Pilgrim, 2012; White, 2013). Australia has charted a course into this transformation which could alter the organization and structure of schooling itself (Downes, et al, 2001).

The status placed on technology has also been reflected in the DER, Australian National Curriculum and Melbourne Declaration (Department of Education, Employment &

Workplace Relations, 2008; ACARA, 2014; MCEETYA, 2008). These documents recognise the importance of technology in current society and acknowledge students need to be educated in its appropriate use through the acquisition of 21st century skills and knowledge.

From the preliminary research conducted by the researcher into this topic it is evident there is a focus placed upon how a 1:1 technology based environment affects student learning, achievement and engagement. However, relatively few studies focus upon the pedagogy required to implement such a program in a way that will enhance the learning of students and ensure they develop 21st century skills.

The impact and influence of the various stakeholders in the classroom is highlighted in the research of Professor John Hattie. Hattie examined the influence of various teaching interventions on student learning (Australian Council for Education Research [ACER], 2003). The effect size of each intervention was measured so as to compare their effectiveness and influence in the classroom. From this research it can be concluded that the teacher exerts the greatest influence on student learning, with 21 of the 29 influence sources identified with the teacher (ACER, 2003). This research highlights the influence the teacher has on the classroom and indicates it is vital for teachers to be practicing quality pedagogy to ensure students are undertaking authentic learning experiences and building on their prior knowledge. Therefore, if students are involved in a 1:1 technology based learning environment it is imperative the teacher develops his/her pedagogy to provide an authentic learning experience utilising the technology and integrating it into the existing curriculum and classroom routines.

2.3 Worldwide Adoption of 1:1 programs

Since their introduction during the 1980's there has been a movement towards the integration of computers and technology into schools (Keane, Lang & Pilgrim, 2012, p.

29; Redmond, 2011). This trend has moved towards the implementation of a 1:1 classroom ratio, where each student has access to a personal device (Larkin & Finger, 2011; Keane, Lang & Pilgrim, 2012). Bate, MacNish and Males (2012) who conducted a study of 196 students over a three year period with a rigorous methodical process, noted the increase in the number of schools implementing personal device programs has been encouraged by the decrease in unit cost of a device. Also, computing companies are directly supplying devices to schools through bulk purchasing schemes. This drop in unit cost along with the increasing value society places upon computers and technological skills have seen a worldwide move in education towards making a "digital turn", where students can access a wide range of technology in the classroom (Buchanan, 2011, p. 67). This educational "digital turn" has been brought on through the evolution of society into the digital age (Buchanan, 2011, p. 67). This has meant education must also evolve to accommodate societal changes and ensure students develop the necessary knowledge and skills to effectively function and contribute to 21st century, technology driven society (Reading & Doyle, 2013).

As a result, countries from all corners of the world including the United States of America, Haiti, Brazil and Columbia are implementing 1:1 technology based learning environments in schools (Severin & Capota, 2011). As identified by Severin and Capota (2011, p. 14) large numbers of devices are being distributed in both Primary and Secondary schools in countries such as Argentina (360,000 laptops distributed), Chile (30,000 laptops distributed) and Uruguay (420,000 laptops distributed). It is the belief in many of these countries that the introduction of 1:1 laptops will assist schools in providing higher quality education, increase motivation of students and encourage students who do not participate in any form of education due to their location, social or cultural values and beliefs (Severin & Capota, 2011, p. 10).

2.4 Pedagogical Adaptations

Rogers (1995, p. 206) identified five stages in the adoption of innovation, thus describing "the rate by which individuals adopt a new idea" over a period of time. These five stages of: innovators, early adopters, early majority, late majority and laggards can be applied to schools implementing 1:1 technology based learning environment programs, and also to the adoption and enthusiasm shown by teachers in such schools. Teachers who embrace the technology, through trying out new strategies in the classroom are the innovators; and those who are more reluctant to use technology in their classrooms are classified as the late majority or laggards.

The large scale extensive research project Apple Classrooms of Tomorrow study 1 (ACOT1) outlined five instructional stages that describe teachers' integration of a 1:1 device program in the classroom (Dwyer, Ringstaff & Sandholtz, 1990). The five instructional stages are highlighted in Table 1 comprising Entry, Adoption, Adaptation, Appropriation and Invention. These progress from a more traditional teaching model at the entry stage (ibid). The entry stage describes teachers utilising the principles of traditional schooling; many "teachers found themselves facing first-year teacher problems" due to the vast change in dynamic of the learning environment where behaviour management and resource management strategies needed to be altered (ibid, p. 4). During the adoption stage, teachers began to grasp the technology better within classrooms, however, they still regressed towards "text based, drill-and-practice instruction" (ibid, p. 4). During this stage teachers also improved in managing the classroom environment, including anticipating behaviour disruptions (ibid). Through the progression as classrooms moved towards the adaptation stage, students were more productive through the utilisation of computers (ibid). According to ACOT1, this ensured that students covered the curriculum in great detail, where the teacher placed emphasis on thinking strategies such as higher order thinking to extend students and

enrich the curriculum (ibid). For the classroom to proceed into the next phase of instruction, the teacher needed to have "personal mastery" of the device (ibid, p. 5). The Appropriation stage emerges when the teacher is able to understand how to use the device efficiently and where the device becomes an integral part of the learning environment (ibid). Upon reaching this stage, the teacher's approach evolves to encompass less traditional instructional methods (ibid). The teacher's role becomes more facilitative in comparison to the bearer of all knowledge in the classroom environment (ibid, p. 6). Teachers were no longer intimidated by their students' more extensive knowledge in regards to the function and use of the device and became more flexible in their approach to teaching curriculum (ibid, p. 6). This evolves to a more "lecture-recitation-seatwork model" in comparison to the invention stage where technology is integrated into the learning time of students through planning of "dynamic learning experiences" (ibid, p. 2). The ACOT 1 study has not been able to articulate what this invention stage looks like in terms of teacher practice and the classroom environment. It did however, suggest the invention stage is "a placeholder for future development by ACOT teachers and for the new learning environments that they will create" (ibid, p. 6).

The second Apple Classrooms of Tomorrow- Today (ACOT 2) study highlights the progress 1:1 programs have made since the initial ACOT 1 study. Since the ACOT 1 study there have been a greater number of schools implementing 1:1 programs with teachers developing their practice and integration of the devices into the classroom environment (Apple, 2008). ACOT 2 concluded with the identification of six design principles for 21st century learning, including 21st century outcomes, relevant and applied curriculum, informative assessments, social and emotional connection, culture of creativity and innovation and 24/7 access to tools and resources (Apple, 2008). To implement these principles in the classroom teachers must first be fluent with the use of 1:1 technology within

their classroom, and the associated pedagogical practices and strategies for integration of the device into the classroom environment and curriculum.

The innovation adoption theory of Rogers can be critically synthesised with the stages and principles of the ACOT studies (see Table 1). A projection from these sources shows that 1:1 technology based learning environments in today's classrooms should encompass a more well-rounded future pedagogy where routines with the devices are established. Teachers can allow students to use the devices in such a way that they become seamless and built into the environment of the classroom and routines. Students use the devices as an information source, but also in a transformative way, whereby they engage with the device spontaneously, developing their 21st century learning skills and content knowledge as facilitated by the teacher. The classroom shifts from a direct instruction model towards a student centred approach, where students and teacher work together in a collaborative environment and where at times students take the lead and the teacher takes on more of a "facilitator of learning" role. This description aligns with a seamless assimilation model where devices are not only an extension of content or an avenue for publishing, but are used as a learning tool for exploration where students develop 21st century skills. This method of seamless assimilation can be extended beyond the constraints of the school grounds where the school utilises online learning environments both inside and outside the classroom. Through online learning environments students have unlimited access to content and teaching materials and once again the teacher's role shifts towards being more of a facilitator of learning rather than the bearer of all knowledge. The lines between classroom learning and home learning become transparent, where students are able to engage with content outside of classroom time.

Table 1: 1:1 Computing instructional stages and skills.

Rogers Innovation rate of adoption.	**ACOT 1:**	

(Rogers, 1995, p. 214)	**Instructional Stages** (Dwyer, Ringstaff & Sandholtz, 1990)	**ACOT 2:** (Apple, 2008)	**Synthesis/Analysis**
Innovators (2.5%)	Entry	Understanding 21st century	Minimal Usage
Early adopters (13.5%)	Adoption	Relevant and applied curriculum	Direct Instruction Usage
Early majority (34%)	Adaption	Informative assessment	Substitution
Late majority (34%)	Appropriation		Integration
Laggards (16%)	Invention	A culture of innovation and creativity.	Seamless Assimilation in the classroom
		Social and Emotional Connections with students.	Use of online learning environments.
		Ubiquitous access to technology.	Integration of online learning environments beyond the classroom.

Throughout the research conducted by Professor John Hattie, the teacher was identified as the source of the greatest influence across various elements of the classroom environment (ACER, 2003). This was reflected when examining traditional classroom environments where the teacher is the central figure. The teacher's emotional link to classroom practice is reflected in their progression of instructional stages identified in the ACOT 1 study. The instructional stages (see Table 1) outline the progression of the teacher's ability to plan for the utilisation of the devices within the everyday routines and practices of the classroom environment. Throughout the progression, the teacher becomes more confident with their knowledge and skills in relation to the mastery of the device and ability to refine their practice to use the devices to enhance learning outcomes.

As described, the use of 1:1 devices in the classroom is strongly connected to the emotional state of the teacher, their 21st century knowledge and skills, the teacher's pedagogy and their willingness to plan for the use of the device in the classroom environment. This, in addition to the strong influence of the teacher in the classroom environment, means that the teacher's pedagogy in a 1:1 technology based classroom environment must be developed and altered in order to move through the instructional stages identified in ACOT 1, implement the six design principles from the ACOT 2 study and provide students with an authentic learning experience that is beyond using the device as a substitution tool. Therefore research question one (RQ1) explores the adaptations in pedagogy made by teachers in this environment to ensure the technology is used in a way that assists students with the development of 21st century knowledge and skills through a comprehensive classroom program.

> RQ1: What is the nature of pedagogical adaptations teachers make when transitioning from technologically less well equipped classes to classes where every student has a personal computer?

2.5 Role of the teacher

According to Finger, Russell, Jamieson-Proctor and Russell (2007) there has been a shift in focus placed upon teachers to ensure they are competent teaching within technology rich environments, including those with 1:1 ratios. Teachers must have the ability to successfully integrate ICT into both planning and teaching practices (Finger et al, 2007). It is also evident that many teachers lack the required Technological Pedagogical Content Knowledge (TPACK) to alter their pedagogy to suit the enriched ICT learning environment of a 1:1 classroom (Mishra & Kohler, 2007; Reading & Doyle, 2013; Sangni, 2013). Reading and Doyle (2013) conducted a large scale study of 41 institutions, and highlighted the most

important aspect of utilising the infusion of technology within the classroom is ensuring the teacher has the relevant knowledge and skills to be able to use it (Sangni, 2013). The ability to teach effectively with ICT within the classroom is also a focus area of the National Professional Standards for Teachers released by the AITSL (2011, p. 11). Teachers of all experience levels need to have the knowledge and ability to integrate the use of ICT for both teaching and learning capabilities within the classroom environment (AITSL, 2011; Lloyd & Mukherjee, 2013).

There has been limited research (see Table 2) conducted in the area of teachers' pedagogy providing insights into the specific skills teachers use to accommodate the 1:1 technology based learning environment. This includes the work of Fariman (2004), Lowther, Strahl, Zoblotsky and Huang (2008) and Peck, Clausen, Vilberg, Meidl and Murray (2008) who together concluded that teachers are most likely to take on a facilitator role within the classroom with 1:1 technology (as cited in Corn, Tagsold & Patel, 2011; Pally, 2013). Through their extensive study of eighteen American High Schools, Corn, Tagsold and Patel found that when teachers took on the role of the facilitator, the learning environment took on a constructivist style, with students becoming more self-directed learners (2011; Dunleavy, Dexter & Heinecket, 2007; Keane, Lang & Pilgrim, 2012; Looi et al, 2011). While MCEETYA suggests the infusion of ICT into the classroom environment can "transform the teachers role by creating new learning environments" these learning environments are not defined (2003, as cited in Finger, Russell, Jamieson-Proctor & Russell, 2007, p. 44). As Corn, Tagsold and Patel (2011) noted through their large scale study, many teachers found the 1:1 ratio of laptop computers to children assisted them to cater for the individual and personal needs of students (Kukulska-Hulme & Traxer, 2007). However, they did not describe what this entailed in terms of differentiation and pedagogy during class time.

As suggested by Reimann and Goodyear (2004) there are five Pedagogy and ICT integrative frameworks that are used within classrooms for learner-centred utilisation of ICT (as cited in Finger, Russell, Jamieson-Proctor & Russell, 2007). These include: Problem-oriented and case-oriented pedagogies; inquiry-oriented pedagogy; design-, modelling-, and construction oriented pedagogy; knowledge-building pedagogy; and immersive learning pedagogy (Reimann & Goodyear, 2004, as cited in Finger, Russell, Jamieson-Proctor & Russell, 2007, p. 127). These pedagogical frameworks specifically apply to the planning for the use of ICT within the classroom, rather than the teachers' implementation, skills, learning strategies and techniques used for the implementation of a 1:1 technology based learning environment. As discussed by Kukulska-Hulme and Traxler (2007), 1:1 technological environments have great potential for not only improving teaching and learning, but also for encouraging the use of non-traditional methods of pedagogy. However, these studies do not identify the key features of these non-traditional methods (as cited in Keane, Lang & Pilgrim, 2012). Keane, Lang and Pilgrim undertook a one year study with 120 participants at two schools implementing netbooks and iPads, where results were limited in the area of pedagogy which was highlighted through teachers merely listing how they used the devices rather than the ways they integrated them into the learning program.

Table 2 highlights the gap within the literature relating to the proposed project with searches conducted on available databases using key terms relating to the topic question and aims.

Table 2: Database search results

Search terms Database	One to one	One to one + laptop	One to one + laptop + transformation of practice	One to one+ laptop+ transformation of practice+ pedagogy
UTAS Library	91 071 984 (100%)	695 685 (0.76%)	17 423 (0.02%)	2 571 (0.00%)
ProQuest	152 498 124 (100)%	770 869 (0.51%)	27 031 (0.02%)	7 556 (0.00%)
ERIC (via ProQuest)	207 559 (100%)	318 (0.15%)	2 (0.00%)	0 (0.00%)

As described in Table 2, there is extensive literature regarding 1:1 technology in the classroom associated with measuring its impact through comparing student achievement levels. However, there has been little research focused on the teachers and the growth in their ability to utilise the 1:1 technology in their classrooms on a routine basis. Therefore, focused research on teachers' pedagogy in a 1:1 technology based learning environment will strengthen the research basis for 1:1 devices in education and inform future teachers about the type of pedagogy required within these environments. This use of non-traditional pedagogy in relation to the operation of teachers in 1:1 technology based learning environments has yet to be researched in depth. After the identification of pedagogical adaptations of these teachers it is important to consider which of the adaptations implemented is most effective. Therefore, research question two (RQ2) seeks to discover the effectiveness of the teacher's adapted pedagogy in a 1:1 technology based learning environment.

RQ2: Which of these adaptations is most effective?

2.6 Learning with Computers

As outlined by ACOT 1, technology has the ability to assist with engagement and productivity of students. For example, students in a year 6 class were able to cover the entire year's mathematics curriculum in 60% of the time, with test scores of the same standard as the previous years (Dwyer, Ringstaff & Sandholtz, 1990, p. 5). Teachers commented that through the use of 1:1 computers in the classroom, students were not only able to cover a large amount of curriculum, but also develop their higher order thinking strategies and engage in deep critical thinking (Dwyer, Ringstaff & Sandholtz, 1990). However, Dwyer, Ringstaff and Sandholtz (1990) do not discuss the changes in planning or teaching made to enable for this accelerated learning. In addition to this, ACOT 2 found that students learning within 1:1 technology based learning environments engaged with 21st century learning skills encompassing the three major headings of 'information media and technology skills, learning and innovation skills and life and career skills' which were identified as the desirable traits for 21st century employees (Apple, 2008, p. 14-15). Studies focused on student outcomes of 1:1 technology based learning environments have demonstrated that students show a greater capacity to conduct self-directed learning, they display a higher level of engagement and motivation towards their schooling with many classes recording improvements in attendance rates and fewer disciplinary issues (Apple, 2008). Therefore, the third research question (RQ3) considers whether 1:1 technology based learning environments improve not only teacher practice, but also the performance, engagement and attendance of students.

RQ3: How are the answers to RQ 1 and RQ 2 dependent upon the prescribed curriculum and accountability processes?

2.7 Conclusion

Although the literature reviewed highlights insights into the pedagogical changes teachers have made to accommodate 1:1 technology based learning environments, there is not a focus on teachers' pedagogy nor comparisons made between the teachers' technology altered pedagogy and more traditional methods of teaching. These studies have also not explicitly stated or considered how and why the teacher made these changes to their pedagogy in light of being placed within a 1:1 technology based learning environment. Therefore, the overarching aim and associated research questions of this project focus upon the alterations teachers have made to accommodate the technology rich environment. This project aims to explore the reasons why teachers have made these alterations and draw out common themes which may, or may not, align with the existing literature by answering these research questions:

RQ1: What is the nature of pedagogical adaptations teachers make when transitioning from technologically less well equipped classes to classes where every student has a personal computer?

RQ2: Which of these adaptations is most effective?

RQ3: How are the answers to RQ 1 and RQ 2 dependent upon the prescribed curriculum and accountability processes?

Chapter 3 describes the methodology and procedures implemented by the researcher to answer the three Research Questions and to identify 1:1 technology based learning environment pedagogy.

Chapter 3. Methodology

3.1 Introduction

As previously discussed, it is important teachers have the required pedagogical and operational knowledge to effectively utilise technology in their classrooms. Through the exploration of their experiences and associated documents, this study aimed to understand phenomena in relation to the adaptations made to pedagogy in a 1:1 technology based learning environment. This approach relied on emerging themes to arise from the data to derive pedagogical adaptations. For this project, a positivist approach to research was implemented with; the underlying philosophical assumption that teachers' pedagogy can be measured and therefore inferences can be drawn from the data to unearth pedagogical adaptations of teachers in 1:1 technology based learning environments (Myers & Avison, 2002).

The purpose of this research project was to determine the pedagogical traits of teachers operating within 1:1 technology based learning environments. The project used the definition of pedagogy from Hall, Murphy and Soler who classify teacher's pedagogy under the four domains of "subject and curriculum knowledge, teaching repertoire of skills and techniques, teaching and learning models and conditions for learning' and 'encompasses the theory and practice of supporting other people's learning."(2008; Reimann & Goodyear, 2004, p.11 as cited in Finger, Russell, Jamieson-Proctor & Russell, 2007, p. 125). This definition was used as the underlying guiding pedagogical definition for this research. The collection of key documents, interviews with teachers and inclusion of the EdFutures study data partnered with the use of grounded theory, comparative document analysis and triangulation of data allowed themes to emerge directly relating to the underlying definition of pedagogy. Expanding upon these domains of pedagogy, themes were identified in relation to the role of the teacher within the classroom, presentation of content, communication with

students, behaviour management, student engagement strategies, assessment and catering for student diversity to address the guiding research questions previously mentioned (Twining, 2013; Hall, Murphy, & Soler, 2008).

RQ1: What is the nature of pedagogical adaptations teachers make when transitioning from technologically less well equipped classes to classes where every student has a personal computer?

RQ2: Which of these adaptations is most effective?

RQ3: How are the answers to RQ 1 and RQ 2 dependent upon the prescribed curriculum and accountability processes?

This chapter outlines the methodological process the researcher undertook to analyse collected key documents and interview transcripts from three sources, utilising an approach allowing pedagogical themes to emerge from the data.

3.2 Justification of Research Method

With the emergence of 1:1 technology based learning environments it is essential that teachers possess the necessary knowledge and skills to fully utilise the capability of the devices in their classroom (Finger et al, 2007). Teachers need to be aware of the impact of technology on pedagogical approaches they use throughout student learning time. To examine these pedagogical approaches a range of investigative tools were considered. The method selected enabled the researcher to construct theory from a variety of sources due to the emerging nature of this field (O'Leary, 2010). Therefore, a qualitative approach was decided upon to deeply explore the experiences of teachers in this classroom environment. Due to the emerging nature of this field, a methodological approach that required the researcher to hypothesise about the findings of the research topic was deemed to be unsuitable as it would not allow pedagogical adaptations of teachers to emerge from the

data due to the unpredictability of research outcomes (O'Leary, 2010). Therefore, grounded theory and action research were considered appropriate methodological approaches for this project. However, action research would require the researcher to work closely with stakeholders to "generate knowledge in order to action change" and due to the time constraints and practicality of this approach it was not considered suitable for the project (O'Leary, 2010, p. 102).

The methodological approach that was chosen to complete this study was that of a qualitative nature based on a grounded theory approach. Grounded theory was selected as the most appropriate method to analyse the pedagogical adaptions of teachers because it considers a large range of documents and allows the researcher to construct theory from the data collected (O'Leary, 2010). This approach is also suited to a system or process that is emerging, rather than a pre-existing system that has been in place for a substantial period of time (O'Leary, 2010). This was due to the nature of the topic and minimal targeted research available that is directly focused upon the pedagogy of teachers within the 1:1 technology based learning environment. Therefore, theory was built upon the foundations of data collected through interviews and document analysis and was guided by emerging themes derived from the lived experiences of teachers in 1:1 technology based classrooms, which could not be as successfully completed through other methodologies (Corbin & Strauss, 1990).

3.3 Grounded Theory

Grounded theory as discussed by O'Leary (2010), was used to theorise about the alterations in teacher pedagogy when in a 1:1 technology based learning environment. In order to successfully fulfil the aims of the project data was collected from a range of documents as outlined in Table 4. In addition to this, interviews were conducted with

participating teachers in a semi-structured style based around the themes that have risen from the analysis of literature, with participants considering and elaborating on these identified key themes and areas of interest. This was an advantage of a theme based approach to research because it not only gave consistent, comparable information, but also allowed for any unexpected themes to arise, enabling the interviewer to explore these themes in detail through unplanned conversation (O'Leary, 2010). Through the process of grounded theory key themes across data collected were used to elicit the alterations in pedagogy that teachers make to fully utilise the 1:1 technology based learning environment.

3.4 Sources of Data

This research project was conducted in Northern Tasmania with the participation of three schools; two Primary Schools within the Catholic Education system and one Senior Secondary Independent School. The selection of these schools is discussed in section 3.5. The research involved six teachers who provided key documents to build an accurate picture of their pedagogical journey before and after the 1:1 technology, in addition to participating in an interview with the researcher. Through the conducted interviews and analysis of key documents (see Table 4) the researcher constructed an overall picture of the circumstances of each teacher's classroom environment and practices. Also contributing to this study was secondary data which originated from the Australian section of the Edfutures[1] study conducted by Professor Peter Twining from the Open University, England. EdFutures study data included in this enquiry encompassed teacher (Principal, classroom and ICT coordinators), parent and student interviews and lesson observations (Appendix 1 *Ethics Approval number* H13438). Through the inclusion and analysis of this additional data,

[1] http://edfutures.net/Main_Page

pedagogical traits were identified through a grounded theory approach contributing to data gathered by the researcher.

3.4.1 Time Scale

This project was conducted as part of an embedded Honours Program associated with the Bachelor of Education-Primary. To be eligible for the Honours Program the researcher completed a preparatory subject during semester 2, 2013, where the initial topic was outlined and researched, potential university supervisors were contacted and a research proposal was completed. Once the researcher received confirmation of acceptance into the Honours Program the supervisor was contacted in December 2013 and the project's Ethics Application was composed and submitted by January 2014. Approval (Appendix 2 *Ethics approval number* H13829) from the University of Tasmanian's Ethics Committee was achieved in early March, 2014.

The researcher then contacted schools in Northern Tasmania who met the requirements of the study and held initial meetings with the Principal of each school in March. After these initial meetings, the Principal of each school was given five invitations to distribute to staff members who were working within the 1:1 technology based learning environment and possessed the characteristics of activists and innovators in relation to the inclusion of the devices on a regular basis in their classroom. These teachers were asked to contact the researcher or Principal if interested in volunteering for the project. During this time the researcher worked towards composing the first three chapters (introduction, literature review, and methodology) as required by the associated Honours based subject undertaken during semester 1, 2014. After receiving contact from the three schools who each had at least one teacher willing to participate in the study, interviews were scheduled in either May or June, 2014.

After the completion of interviews, transcripts were composed and approved by participants in June or July. The researcher then began to analyse the data gathered and write up findings to form the final chapters of the project. Executive summaries of findings were also composed and given to participating schools. The project was completed to coincide with the conclusion of semester 2, 2014 in October.

3.4.2 Selection of Schools

From an initial investigation, including viewing each school's website and through discussions with colleagues at the University of Tasmania, three schools within Northern Tasmania were identified to have in place 1:1 technology based learning environments (school profiles see Table 3). A convenience sample selection technique was implemented due to a number of factors including the targeted nature of the study, limitations in terms of the number of schools in Northern Tasmania utilising this type of program and time constraints associated with the project's timeline. Each of the participating schools was selected on the basis of the time period their 1:1 technology based learning environment programs have been in place and their geographical location in comparison to the researcher. It was required that the 1:1 technology based learning environment program had to have been running for a period of at least two/three years aligning with the theory that after this period of time teachers are only beginning to feel comfortable with the large amount of technology which a 1:1 ratio brings into the classroom environment (Bebell & Kay, 2011; Corn, Tagsold & Patell, 2011).

Table 3: Participant School Profiles

School	1:1 Device	School ICSEA Value	Student Population	No. of students 1:1	% of school covered by wireless network	Bandwidth connection per student	Download Limit per student
School A	iPads	105x	300-400	120	98%	No Restriction	No Restriction
School B	iPads	98x	150-200	111	100%	No Restriction	No Restriction
School C	Windows Surface Tablet Pro	112x	1000-1100	127	95%	No Restriction	No Restriction
School D	iPads	108x	1000-1100	N/A	N/A	N/A	N/A
School E	Laptops/iPads	100x	700-800	Grades 8-12s	N/A	N/A	N/A
School F	Samsung Tablet	100x*	200-300	N/A	N/A	N/A	N/A
School G	Samsung Tablet	103x*	1750-1900	Grades 7-12	N/A	N/A	N/A

All school data accessed from the MySchool Website for the 2013 school year (www.myschool.edu.au)

x- Has been used to ensure the anonymity of participant schools.

N/A-indicates schools that the researcher did not have access to the corresponding information.

*School G and School F did not have a recorded ICSEA value and therefore, a value has been assigned to this school based on the average of the other schools in the area.

Table 4: Purpose of Key Documents

Category of Data	**Item**	**Research Question:**	**Data to be collected**	**Method of collection**	**Reason for collecting this data**	**Method of Analysis***	**Integration of Findings**
School Policy Documents	Behaviour Management Policy	RQ1 RQ2	Classroom agreement. School agreement.	Photo copies/ electronically sent.	Analysis of changes in the methods used. (the Principal may be called upon to elaborate on the changes identified)	CDA	Triangulation
	ICT policy/agreement.	RQ1	School agreement.	Photo copies/ electronically sent.	Analysis of how the devices are to be used within the school.	CDA	
	Professional Development (notations, information sheets)	RQ1 RQ2	Information sheets. Teacher notes.	Photo copies/ electronically sent.	Analysis of information about 1:1 teaching/learning teachers have engaged with.	CDA	
Interviews	Answers to key questions (Interview + Transcripts)	RQ1 RQ2 RQ3	Answers to key questions regarding alterations in teaching pedagogy.	Face to face interviews.	To draw out key themes and pedagogical methods. Elaboration on key documents collected.	GT	
	EdFutures data	RQ1 RQ2 RQ3	Interview transcripts from teachers, parents and students.	Electronic.	To draw out key themes and pedagogical methods. Student and parent interpretations of programs.	GT	

*CDA-Comparative Document Analysis, GT- Grounded Theory

3.4.3 Conduct of Interviews

The interviews had a semi-structured format where open ended questions were used to allow the participants to elaborate and explore their altered pedagogy and the reasons behind these alterations (O'Leary, 2010). This was an advantage for this type of theme based project because it ensured consistent, comparable information, but also allowed for any unexpected themes to arise as the researcher had the ability to explore themes in detail through unplanned conversation (O'Leary, 2010). The basis of the interview schedule for each participant was informed by the research of Corn, Tagsold and Patel (2010) and Bingimlas (2009). Interviews were conducted in a space where the participant felt they could speak freely and be undisturbed for the duration of the interview. Through their participation in this study teachers were able to critically analyse their pedagogy with the aim of identifying the alterations they had made, and also to improve their skills and practice in 21st century teaching. After the completion of interviews, the participants had the opportunity to review the transcript of the conversation prior to the analysis to ensure the accuracy and that it did not contain anything they would regret their employer reading.

3.5 Analysis of Data

3.5.1 Grounded Theory

Grounded Theory was used to analyse the following documents:

- Conducted Interviews
- EdFutures Interviews
- Professional Development Information

3.5.1.1 Open coding

After the completion of interviews, the transcripts were analysed through the process of open coding. As discussed by Corbin and Strauss, the purpose of open coding assists the researcher to gain insight into the information reflected in the data (1990). Transcripts were broken down through the process of line-by-line coding, where each line was categorised according to its content, significance and relevance to pedagogical characteristics (Corbin & Strauss, 1990). The emphasis during coding was placed upon identifying the characteristics of teachers' pedagogy when operating in a 1:1 technology based learning environment. This deconstruction of data assisted the researcher to sort and make comparisons about similarities and differences of participants' pedagogy and therefore, identify common characteristics of the pedagogy of participant teachers interviewed (Corbin & Strauss, 1990). Throughout this process various "conceptually similar events/actions/interactions are grouped together to form categories and subcategories" (Corbin & Strauss, 1990, p. 12).

3.5.1.2 Axial coding

Axial coding was used to further analyse the data and identify new relationships between categories (Corbin & Strauss, 1990). This stage of analysis enabled the researcher to condense the coded data down into manageable related categories, making explicit linkages between codes to create themes (Corbin & Strauss, 1990). This enabled the researcher to identify patterns relating to 21st century pedagogy that were consistent across the interviews.

3.5.1.3 Selective coding

The identified themes were then further categorised through selective coding based upon their relation to the facet of teachers' pedagogy (Corbin & Strauss, 1990). These categories aligned with the domains of pedagogy as identified by the definition described by Hall, Murphy and Soler, (2008) encompassing the role of the teacher within the classroom, presentation of content, communication with students, behaviour management, student engagement strategies, assessment and catering for student diversity (Corbin & Strauss, 1990).

3.5.2 Constant Comparative Analysis

The data analysis, specifically the selective coding phase, was then guided by a comparison method of the participant interviews. This method of data analysis was used to look for "recurrent and emerging themes to identify patterns" between each of the different teachers pedagogical data gathered, determining the key alterations they have made to effectively utilise the 1:1 technology based learning environment (Lincoln & Guba, 1985 as cited in Redmond, 2011, p. 1053; Fram, 2013). Axial coding brought related codes together to create themes (Corbin & Strauss, 1990). This data was then comparatively analysed against the interview data through selective coding and related to the key pedagogical domains identified.

The result of this process is a theory that has been derived from documentation which is "grounded in the data and positioned in context with the literature" (Corbin & Strauss, 1990, 1998 as cited in Warburton, 2009, p. 258). Open, axial and selective coding and the method of constant comparison were utilised to ascertain emerging themes and patterns between each of the different teachers' pedagogical characteristics to determine key alterations they have made to

effectively utilise the 1:1 technology based learning environment (Lincoln & Guba, 1985 as cited in Redmond, 2011).

3.5.3 Policy Document Analysis

Schools were requested to provide the following documents as participants in this study: behaviour management policy, ICT/device user agreement/contract and any professional development notes/information sheets. Each policy document was provided by schools or sourced from their school. The documents were reviewed against seven criteria developed by the researcher following issues that had arisen from the grounded theory analysis. Each policy document was analysed to see if it covered the item in each criterion. However, for some schools the researcher was unable to locate or was not provided with the required key document and this was noted. Each criterion was then aligned with one of the three guiding research questions and then triangulated with the interview transcript results.

3.5.4 Triangulation in the Social Sciences

The final stage of data analysis consisted of bringing together the three sources of data, Tasmania teachers' interviews, key document analysis and the interviews and observations from the Australian EdFutures study. This was completed through a within-method triangulation of the selective codes derived from the data (Mathison, 1988). As discussed by Denzin, triangulation assists the researcher in validating the collected data allowing commonalities between each data type to emerge and highlighting the specific pedagogical traits of a teacher in a 1:1 technology based learning environment (1970, as cited in Mathison, 1988). Through the triangulation method all sources of data were compiled to map out the pedagogical adaptations of participant teachers (Cohen & Manion, 2000).The coded data was broken down further to cross

reference the commonalities between the data sets and reveal pedagogical traits of teachers in a 1:1 technology based learning environment teachers. These commonalities were then used to map out and explain 1:1 pedagogy in relation to the underlying definition of pedagogy (Cohen & Manion, 2000).

3.5.5 Reliability of Research

The reliability of research is determined by the consistency of the approach taken by the researcher (O'Leary, 2010). The methodological approach throughout the process of collecting data through interviews with the participants remained consistent. Each participant and associated school was asked to provide the same key documents (Table 4). To remain consistent, but to also ensure that themes not addressed by the researcher's interview schedule were not omitted, the interviews were semi-structured in style with the researcher using a series of questions which remained consistent for all participants in the study. The researcher then transcribed each interview soon after its completion and undertook an analysis utilising the principles of grounded theory and comparative document analysis for each piece of data collected. This ensured that all data was analysed in the same manner for each participant therefore, maintaining the reliability of documents and methodology.

3.5.6 Validity of Research

As outlined by Huitt, Hummell and Kaeck (1999), research must be tested for validity both externally and internally. External validity seeks to generalise the findings of this research to the entire population of teachers in a 1:1 technology based learning environment (Huitt, Hummel & Kaeck, 1999). To overcome this threat to the research a variety of teachers

from both a Primary and Senior Secondary schools participated in the study to ensure that the pedagogical adaptations in a 1:1 technology based learning environment were accurately identified. In addition to this, of the three schools, two different types of devices (iPads, Windows Surface Tablet Pro) were used also validating the research project's ability to generalise findings to the population of teachers in a 1:1 technology based learning environment.

To control the internal validity as outlined by Campbell and Stanley (1963), there are a number of threats that the researcher needs to consider when planning and implementing research techniques (as cited in Huitt, Hummel & Kaeck, 1999). Internal validity is most affected by the research design and how it caters for factors such as "history, maturation, testing, instrumentation, regression, selection-interaction effects and ambiguity about the direction of casual inference" (Campbell, 1957; Campbell & Stanley, 1963; Cook & Campbell, 1979; Spector, 1981 as cited in Bergh, Hanke, Balkundi, Brown & Chen, 2004, p. 351). To address these threats the researcher put in place a number of preventative measures to ensure that validity of the research was maintained. These preventative measures included approaching schools who have had 1:1 technology based learning environment programs in place for at least a period of two/three years, therefore, consistent with the research of Bebell and Kay (2011) and Corn, Tagsold and Patell who concluded that a three year period is required for teachers to feel comfortable within a 1:1 technology based learning environment. The researcher also ensured that participants selected a neutral location to be interviewed where they were able to speak freely and remain undisturbed for the duration of the interview, assisting the validity of the data gathered. In addition to this, transcription of interviews was completed soon after they were conducted with the participant given the opportunity to view the conversational transcript to determine its accuracy. When analysing the data the researcher was consistent, utilising grounded

theory and comparative document analysis principles in an authentic way, triangulation of the data then occurred so as to develop themes that were relevant to pedagogical adaptations common to the majority of participant teachers.

3.5.7 Limitations of Research

Due to the nature of an embedded University of Tasmania, Bachelor of Education-Primary Honours Program there were a variety of limitations placed on this research project. Physical limitations in terms of geographical location of the researcher meant that research could only be conducted in Northern Tasmania and ensured that the selection of schools who met the criteria to be able to participate in the study was restricted to three schools within the Catholic and Independent sector. However, this limitation was ameliorated through the inclusion of interviews from the international EdFutures study which was conducted across mainland Australia and Tasmania during 2013, creating a greater scope for the research project. Time constraints placed on the project due to the embedded nature of the Honours Program in conjunction with completing other University requirements of the Bachelor of Education-Primary meant that the research project was only able to be conducted over the course of one University year. Nevertheless, the researcher ensured that the Ethics Application was completed and approved at the beginning of the University year so there was enough time to complete the project. Weekly meetings were held between the researcher and the supervisor to ensure steady progress was made towards the completion of the project and the other academic commitments of the researcher.

3.6 Conclusion

Through the process of grounded theory, comparative document analysis and triangulation the researcher was able to construct an image of the pedagogical traits of teachers who operate within 1:1 technology based learning environments. Collectively the methodological approach and sources of data gathered the required information to address the guiding research questions and fulfil the overall aims of the project. Through the minimisation of threats and consistency of the approach the researcher was able to gather and draw accurate conclusions from a variety of data sources obtained.

Chapter four presents the results of the interview transcripts and key document analysis.

Chapter 4. Results

4.1 Introduction

The previous chapter described the procedures undertaken to gather data about teacher's pedagogy when operating in 1:1 technology based learning environments. The researcher subsequently utilised a qualitative approach towards the research through grounded theory and comparative document analysis to analyse interview transcripts, lesson plans and policy documents. This chapter expands upon the methodological practices outlined in chapter three, through a process of analysing gathered data through open coding and axial coding where themes were identified. A comparative analysis was undertaken for the policy documents supplied by each school against criteria developed by the researcher.

The data for this project came from a series of interviews with teachers from three Tasmanian schools and teachers from the EdFutures study of schools implementing 1:1 technology programs (Twining, 2013). Each interview was transcribed and reviewed by participants in alignment with the ethical approval for this project. Grounded theory was then used to analyse each transcript through a four step process of line-by-line open coding, condensing the codes down through identification of themes in axial coding and then selective coding, where themes were aligned with guiding research questions and analysed against the definition of teacher pedagogy. Policy documents relating to the use of the 1:1 devices in the classroom and home environment were also gathered and comparatively analysed against criteria. Using this data analysis strategy the researcher allowed themes to emerge from the data as a whole, determining the overall pedagogical adaptations of teachers operating within 1:1 technology based learning environments.

4.1.1 Collection of key documents

The researcher was able to conduct interviews with a five of teachers who operate within a 1:1 technology based learning environment. These teachers provided the researcher with key policy documents relating to 1:1 devices in their school and answers to prepared interview questions. However, due to the nature of professional commitments, participant teachers were unable to provide past lesson plans demonstrating their operation and classroom routines prior to the introduction of 1:1 devices. Therefore, a comparative analysis of these documents could not take place. This pressure was also evident for teachers in regards to their professional development opportunities. Many of the participant teachers had not had the opportunity to engage with formal professional development focused on 1:1 technology based learning environments and were therefore, unable to provide the researcher with these documents.

4.2 Open Coding

The process of open coding elicited the emerging themes of participant teachers' discussions during the conducted semi-structured interviews. Directly after each of the interviews a transcript was composed by the researcher and approved by each participant teacher. The researcher developed an initial code book with codes describing ideas expected to emerge from the interview transcripts. Each transcript was then coded through a line-by-line analysis. Additional interview transcripts from the EdFutures study were also line-by-line coded during this process against the created code book (see Appendix 3). This process of open coding allowed the researcher to record the frequency of key discussion topics within each interview.

4.2.1 Emergent Codes

The emerged codes from the open coding process described all facets of a teacher's pedagogy when operating within a 1:1 technology based learning environment. As the interview transcripts were coded, additional codes emerged due to the sensitised immersion of the researcher in the data. These were added to the code book where required. Transcripts were coded using the program Ethnograph (Qualis Research, 6.0.1.0, 2014) where the researcher was able to create a code book, import and code each transcript and generate a tally of the number of times each code was used (see Figure 1).

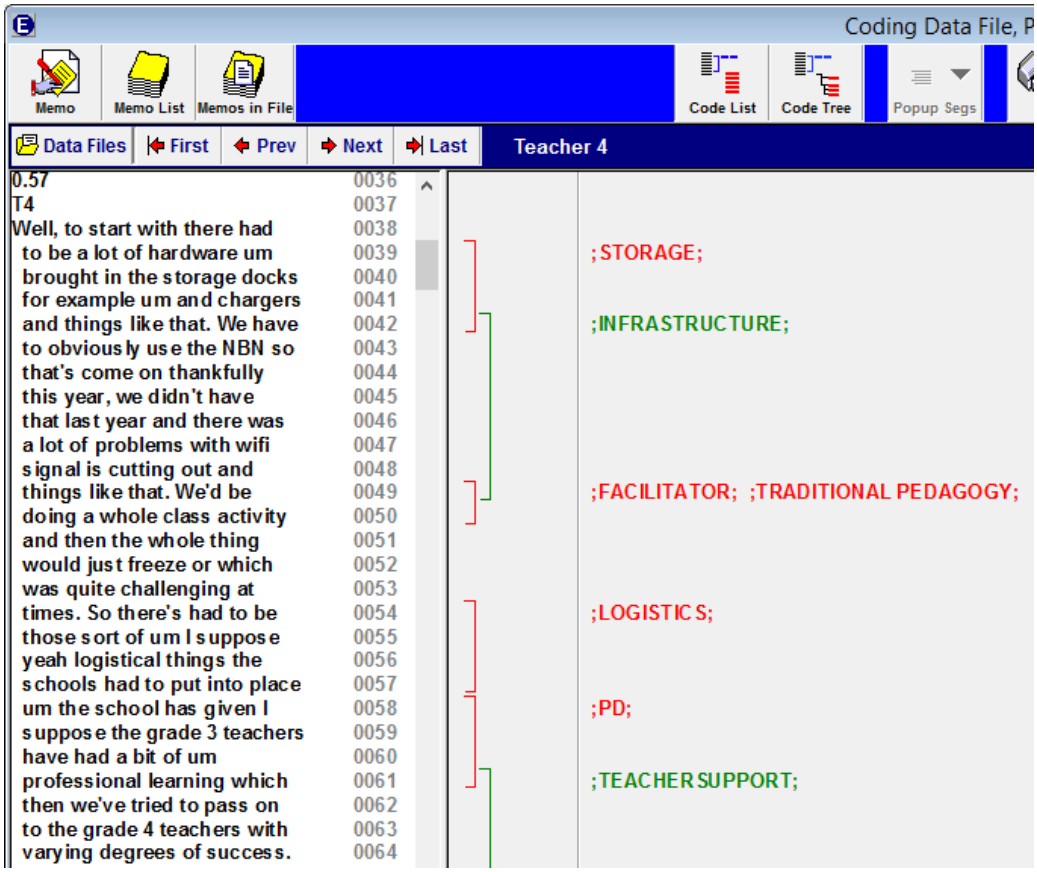

Figure 1: Ethnograph sample coding-interview with Teacher 4

For example in Figure 1 the lines 0039-0042 have been coded *storage* as teacher 4 mentioned how the devices were stored in docks; lines 0042-0049 have been coded *infrastructure* due to the mention of the National Broadband Network being the source of wireless internet within the school. This continues where lines 0058-0061 have been coded *PD* where the participant teacher comments on the professional development that has been undertaken by the teachers within a 1:1 technology based learning environment. For each interview, a code frequency table was generated which was then compiled across all of the interviews as shown in Table 5. For individual teacher responses see Appendix 4.

Table 5: Open code frequencies from six interviews with nine teachers

	Open Codes	**Total Responses**
1	21st Century Skills	105
2	Non-Traditional Pedagogy	91
3	Student Centred	67
4	Planning	55
5	Professional Development	47
6	Policy Agreement	47
7	Teacher Support	44
8	Facilitator	42
9	Engagement Strategies	41
10	Positive Teacher Attitude	41
11	Infrastructure	40
12	Traditional Pedagogy	40
13	Behaviour Management	39
14	Other Devices	38
15	Ubiquitous Access to Technology	38
16	Understanding 21st Century	30
17	Direct Instruction Usage	30
18	Pedagogy	28
19	Parent Attitude	27
20	Teacher Personal Skill	26
21	Accountability	23
22	Substitution	21
23	Culture of Innovation and Creativity	20
24	Differentiation	19
25	Student Attitude	19
26	Collaborative Learning	16
27	Teacher Attitude	14
28	Integration of Online Learning Environments Beyond the Classroom	14
29	Logistics	14
30	Back-up Planning	13
31	Negative Teacher Attitude	13
32	Future Planning	10
33	Student Outcomes	9
34	Online Learning Environment (Synthesis)	9
35	Online Learning Environment	8
36	Negative Effect (Student Ownership)	7
37	Integration (Synthesis)	6
38	Appropriation	5
39	Relevant and Applied Curriculum	5
40	Storage	5
41	Positive Effect (Student Ownership)	3
42	Effect of Ownership	2
43	Entry	1
44	Invention	1
45	Social and Emotional Connection with Students	1

4.3 Axial Coding

Through the axial coding process the researcher was able to reduce the number of codes created during the open line-by-line coding phase into themes. According to the grounded theory axial coding process outlined by Corbin & Strauss (1990), axial coding is utilised to condense the amount of data the researcher is examining through the process of grouping related and/or connecting codes together into themes. This process was completed in a series of stages, where the researcher firstly broke down the codes into categories labelled by stakeholder group. This made the process of axial coding in identifying the commonalities between codes a more meaningful process through the strong link created between the stakeholder groups and the codes derived from participant teacher interviews. Each stakeholder group's open codes were then condensed through the identification of themes/commonalities between codes, and then calculating an associated total weighting for each of the themes according to the code frequency table. Each theme was then linked to its corresponding research questions.

4.3.1 Development of Categories

The first stage of reducing the number of codes for further analysis consisted of a theoretical distribution of codes into stakeholder groups. The researcher categorised codes according to their relationship to teachers, parents, institutions (schools) or students (see bold headings Table 6*)*. Categorising the data this way was a replica of Professor John Hattie's research determining the greatest influences in the classroom (ACER, 2003). During this initial group classification process it was evident that codes such as *accountability* would apply to more than one of these groups and these were distributed accordingly. This ensured the researcher effectively divided up the data into manageable categories that related to all stakeholders

involved in a school who have a vested interest in the use of 1:1 devices in the classroom environment.

4.3.2 Development of Themes

Once the open codes were placed into the categories, the researcher then used axial coding to form sub-groups of codes or themes within each category. This was completed through considering related ideas, concepts and/or practices and connecting those together under descriptive theme headings (see Table 6).

Table 6: Themes emerging from codes in stakeholder categories

Theme	Codes	
Teacher-related themes		
1. Teacher's feelings towards the device	Negative teacher attitude Teacher attitude	Teacher personal skill Positive teacher attitude
2. Development of teaching practices with the device	Teacher support Invention Appropriation Adaption Integration (Synthesis)	Adoption Professional Development Minimal Usage Entry
3. Usage of the Device	Facilitator Collaborative learning Direct instruction usage Differentiation Student centred	Seamless assimilation in the classroom Non-traditional pedagogy Substitution Online learning environment
4. Greater connection to students through device	Ubiquitous access to technology Social and emotional connection with students	Integration of online learning environments beyond the classroom Online learning environments
5. Development of technology literate skills	21st Century skills	Future planning

Theme	Codes	
6. Planning undertaken by teacher/institution	Behaviour Management Other Devices Back up planning Policy agreement	Engagement strategies Planning Pedagogy
7. Expectations of stakeholders	Accountability	Student Outcomes
Student-related themes		
8. Student engagement/ progress with the device	Collaborative Learning	Student Outcomes
9. Control of student activity with the device	Storage	Policy Agreement
10. Students attitude towards the device	Positive effect of ownership Student attitude	Negative effect of ownership
Institution-related themes		
11. Understanding of future educational needs of students	Online Learning environments Culture of innovation and creativity Ubiquitous access to technology Relevant and Applied Curriculum	Understanding 21st Century Professional Development Future planning Integration of online learning environments beyond the classroom
12. Institution Controlled	Accountability Policy Agreement Storage	Other Devices Behaviour Management Infrastructure
Parent-related themes		
13. Parent Expectations	Accountability	Parent Attitude
14. Agreements with Institutions	Policy Agreement	Storage

4.3.3 Explanation of themes

Theme 1- Teacher: Teacher feelings towards the device

Theme one relates to the teachers' personal feelings towards the introduction and use of 1:1 devices within their classroom. Therefore, this theme is constructed from the following codes: *negative teacher attitude, teacher personal skill* and *positive teacher attitude*. This theme considers the positive or negative attitude the teacher has towards the presence of the device in their classroom. For example, some teachers may have a positive attitude about the school implementing a 1:1 program, but a negative attitude in that they do not want the device

implemented in their classroom. This attitude can be linked to teachers' personal skills with the device due to a number of teachers feeling more apprehensive about the device in their classroom because they themselves are not comfortable with using the device.

Theme 2-Teacher-Development of teaching practices with the device

Theme two relates to the development of the teacher's practices within the classroom since the introduction of 1:1 technology based learning environments. Therefore, this theme is constructed from the following codes: *teacher support*, *adoption*, *invention*, *professional development*, *appropriation*, *minimal usage*, *adaption*, *entry* and *integration (synthesis)*. This theme considers the level of implementation within the classroom, how teachers have developed this level of implementation and the strategies utilised within the classroom to implement the devices.

Theme 3-Teacher- Usage of the device

Theme three relates to the usage of the device planned by the teacher in relation to their role in the classroom. Therefore, this theme is constructed from the codes: *facilitator*, *traditional pedagogy*, *seamless assimilation in the classroom*, *collaborative learning*, *non-traditional pedagogy*, *integration*, *direct instruction usage*, *substitution*, *differentiation*, *online learning environment* and *student centred*. This theme considers the teacher's implementation of the device and in turn the shift of their role in the classroom environment.

Theme 4-Teacher- Greater connection with students through device

Theme four relates to the greater connection the teacher can obtain with students through the implementation of 1:1 devices. Therefore, this theme is constructed from the codes: *ubiquitous access to technology*, *integration of online learning environments beyond the classroom*, *social and emotional connection with students* and *online learning environments*. This theme considers the ongoing communication with students beyond the constraints of the school day where students are interacting with the teacher through different modes of communication, such as email.

Theme 5-Teacher-Development of technology literate skills

Theme five relates to the development of technology literate skills by the students stemming from teacher planning. Therefore, this theme is constructed from the codes: *future planning* and *understanding 21st century*. This theme considers the necessary skills students require in order to have mastery of the device in addition to acquiring transferable technology skills that allow them to not only use a variety of devices, but also assess the appropriateness of a device in terms of the final product they want to achieve.

Theme 6-Teacher- Planning undertaken by the teacher/institution

Theme six relates to the planning undertaken by the teacher and/or institution in relation to the operation of 1:1 technology based learning environments within the school. Therefore, this theme is constructed from the codes: *behaviour management*, *engagement strategies*, *other devices*, *back up planning* and *policy agreement*. This theme considers the

additional planning or modification of planning teachers must engage with in order to implement a 1:1 technology based program within their learning environment.

Theme 7- Teacher-Expectation of stakeholders

Theme seven relates to the expectations stakeholders place on the teacher and is therefore constructed from the codes: *accountability* and *student outcomes*. This theme relates to the ongoing expectation placed on stakeholders, especially within a 1:1 technology based learning environment where many teachers interviewed highlighted the greater parental access and connection to what was taking place within the learning environment through online sources such as email, online based learning environments, the school website and/or classroom blogs.

Theme 8- Student-Student engagement/progress with the device

Theme eight relates to the connection between student engagement and academic progress since the introduction of the 1:1 technology based learning environments. Therefore, this theme is constructed from the codes: *collaborative learning* and *student outcomes*. This theme considers the extent to which the use of the device in the classroom creates engaging activities for students and how this in turn affects their progress through the curriculum.

Theme 9- Student-Control of student activity with the device

Theme nine relates to the control the both that student and the school have over the device at any time. Therefore, this theme is constructed from the codes: *policy agreement* and *storage*. This theme considers the degree of control the school has over the device, including if the device is school or student owned, and how this affects the use of the device in the classroom environment.

Theme 10-Student- Students attitude towards the device

Theme ten relates to the students attitude towards having a personal device to use within the classroom environment. Therefore, this theme is constructed from the following codes *positive effect of ownership*, *negative effect of ownership* and *student attitude*. This theme considers student attitude towards the device, including how they view the device as an educational tool or game console, and how this attitude affects their use of the device in the classroom.

Theme 11-Institution- Understanding of future educational needs of students

Theme eleven relates to the institution's understanding of the 21st century educational needs of students and encompasses their justification for implementing a 1:1 technology based learning environment program in the school. Therefore, this theme is constructed from the codes: *online learning environment*, *culture of innovation and creativity*, *ubiquitous access to technology*, *future planning*, *relevant and applied curriculum* and *integration of online learning environments beyond the classroom*. This theme considers the future knowledge and skills students will require and learning students are currently undertaking in order to develop this knowledge and skills.

Theme 12-Institution- Institution Controlled

Theme twelve relates to the control the institution has over the entire 1:1 device program in the school and local community. Therefore, this theme is constructed from the codes: *accountability*, *other devices*, *policy agreement*, *behaviour management*, *storage* and *infrastructure*. This theme considers the controls the institution has put in place in order to facilitate a 1:1 technology based learning environment.

Theme 13- Parents- Parent expectations

Theme thirteen relates to the parental expectations of the use of the device and the student outcomes that will follow as a result of the device being used in the classroom. Therefore, this theme is constructed from the codes *accountability* and *parent attitude*. This theme considers the preconceived expectations of parents, in relation to what they expect their children to be achieving within the program in addition to the appropriate use of the device within the classroom environment.

Theme fourteen-Parents- Agreement with institution

Theme fourteen relates to the signed agreements parents have made with the school in relation to the 1:1 technology based learning environment that their child is learning within. Therefore, this theme is constructed from the codes *storage* and *policy agreement*. This theme considers the agreement made with the school about the use of the device and its storage while not in the classroom.

4.3.4 Summary of axial coding

The initial open coding had produced 50 codes from the interview data. The categorisation of these open codes, followed by axial coding, gave rise to fourteen themes linked to stakeholder groups.

4.3.5 Associated theme code frequency

Once the axial coding stage was complete the researcher moved onto assigning each theme a frequency. Each theme frequency was calculated by adding together the number of times the open codes that make up each theme was mentioned by participants in the interviews.

Themes were then aligned with the guiding research question to which they related and arranged with their corresponding overall code frequencies (see Table 7).

Table 7: Alignment of themes with Research Questions and Code Frequency

Research Question	Themes	Code Frequency
RQ1	6. Planning undertaken by the teacher/institution	261
	3. Usage of the device	226
	11. Understanding of future educational needs of students	172
	2. Development of teaching practices with the device	104
	1. Teacher's feelings towards the device	94
	10. Student attitude towards the device	29
	8. Student engagement/progress with the device	25
RQ2	5. Development of technology literate skills	145
	4. Greater connection to students through device	61
RQ3	12. Institution controlled	187
	9. Control of student activity with the device	60
	13. Parent Expectations	60
	14. Agreement with institution	52
	7. Expectations of stakeholders	32

4.4 Explanation of alignment of research questions and themes

As described in Table 7 each of the 14 identified themes were aligned with the guiding research questions for this project. From this alignment it can be seen that all themes connected to the teacher's actions relate to RQ1 which considers the nature of pedagogical adaptions teachers make when operating with a 1:1 technology based learning environment. From the code frequency for this section it can be seen that teachers discussed the need to undertake extensive planning themselves in terms of classroom usage of the device and also by the institution in terms of its vision for the usage of the devices in the classroom. RQ2 encompasses the effectiveness of the pedagogical adaptations and relates to the themes that consider the ongoing development of student technology literacy skills and the greater connection between teachers and students through using the device. RQ3 considers the relationship of RQ1 and RQ2 have with the prescribed curriculum and accountability process.

For this reason the themes that fall under RQ3 all relate to the controls the institution and stakeholders, such as parents, expect from the implementation of the device.

4.5 Policy Document Analysis

Schools were requested to provide policy documents such as ICT user's policy, ICT agreements between schools, students and parents etc. These documents were assessed against predetermined criteria outlined by the researcher for specific features relating to the use of 1:1 devices in each school. These criteria originated from the key points participant teachers made when referring to the policy documents their school has outlining the restrictions put in place to ensure the implementation of the devices was a smooth process.

4.5.1 Explanation of Criteria

Rationale for implementation

This criterion relates to the justification for the implementation of 1:1 technology based learning environments within the school. This justification may link to literature such as the Melbourne Declaration of Educational Goals for Young Australians or the Australian Curriculum (MCEETYA, 2008; ACARA, 2014).

Outline of teaching staff integration of devices

This criterion relates to the expected usage of the device in the classroom as outlined by the school to give stakeholders an idea of the types of applications the device will have in the learning environment.

Outline of appropriate use of devices

This criterion relates to what the school outlines as the appropriate use of the device both within the classroom environment and outside of school hours. This may include usage at break times (recess and lunch), loading of applications and usage during class (instructed by the teacher).

Connection/communication between students, parents and school through online environment.

This criterion relates to the avenues of connection/communication between students, parents and school. This may be restricted to email or parents may have access to the school's online learning environment through a parent portal where they can see the materials available to their child, a record of homework due dates and submissions etc.

Success Criteria

This criterion relates to the school's outline of success criteria that they aim to meet regarding implementation of the program. These success criteria may relate to teacher use of device within the classroom and student, or teacher and parent usage of online resources including online learning environments.

Agreement between stakeholders (School/parent/student) in reference to the use and care of the device.

This criterion relates to the agreement the school has in place with parents and students in reference to the use and care of the device. This may come in the form of a contract that is signed by all stakeholders prior to the allocation of devices that outlines the expectations for usage and care of the device from the school's perspective.

4.5.2 Collection of relevant documents

The participant schools within Tasmania were able to provide the researcher with the relevant policy documents as requested. However, the researcher was only able to access through the school website some of the policy documents of those schools that participated in the EdFutures study. This resulted in the researcher not being able to conduct some aspects of the policy document analysis with all schools. The inaccessibility of the documents has been symbolised in Table 8 with a dash.

4.5.3 Comparative analysis of policy documents

As demonstrated in Table 8 each document was compared against a set of criteria identified by the researcher in relation to the school's policies in regards to their 1:1 technology

based learning environment program. These criteria were then aligned with the guiding research questions to demonstrate their relevance to the overall aim of the project. When a school had met particular criteria within their policy documents, the researcher recorded this with a tick.

Table 8: Policy Document Analysis and Alignment with Research Questions

Research Question	Criteria	School A	School B	School C	School D	School E	School F	School G
RQ1	Rationale for implementation	✓	✗	✓	✓	✓	✓	✓
	Outline of teaching staff integration of devices. (student expected use in class)	✓	✗	✗	✓	–	–	✗
	Outline of appropriate use of devices. (e.g. consequences, cyberbullying)	✓	✓	✓	✓	✓	✓	✓
	Connection/communication between students, parents and school through online environment.	✗	✗	✓	✗	✗	✓	✓
RQ2	Feature of ownership	✓	✓	✓	✗	✓	✗	✓
	Success criteria	✗	✓	✗	✗	–	✗	✗
RQ3	Agreement between stakeholders (School/parent/student) in reference to the use and care of the device.	✓	✓	✓	✓	✓	–	✓

4.5.4 Evaluation of policy documents

As described in Table 8, each school's policy documents were assessed against predetermined criteria. Each school's policy documents had a rationale for the implementation of 1:1 technology based learning environments with many referencing outside guiding documents such as the Australian curriculum. It was evident that the participant schools' policy documents were mainly focused upon setting boundaries for student usage of the device in terms of outlining consequences for misuse and providing students with an agreement or contract which held them accountable for their actions. In many cases the agreement held students' parents accountable for any damage to the device and outlined suggested boundaries regarding usage in the home environment. Many policy documents omitted information about the school's goals for the implementation of the device, success criteria and the expected integration or usage of the device in the classroom. Nor did they mention a clear direction for what they hoped students and teachers would achieve with the devices.

4.6 Conclusion

This chapter has demonstrated that the process of analysing the data for this project was extensive with the researcher conducting a series of interviews, collecting relevant policy documents and aligning the EdFutures interview transcripts with the guiding research questions for this project.

In Chapter five the results of collected data is analysed and drawn upon to answer the guiding research questions and compared with literature within this field.

Chapter 5. Discussion

5.1 Introduction

The previous chapter outlined the qualitative data collection techniques and the emerged results in relation to the pedagogy of teachers who work within 1:1 technology based learning environments. This chapter discusses the results considering the literature, thematic densities of interviews and criteria based analysis of policy documents in relation to the three guiding research questions for this project:

RQ1: What are the nature of pedagogical adaptations teachers make when transitioning from technologically less well equipped classes to classes where every student has a personal computer?

RQ2: Which of these adaptations is most effective?

RQ3: How are the answers to RQ1 and RQ2 dependent upon the prescribed curriculum and accountability processes?

In the findings for each research question, quotations from the interview transcripts are cited against the number of each teacher and the line numbers in each transcript in addition to key document quotations.

5.2 Research Question 1

The aim of this research question was to uncover the pedagogical adaptations teachers make when transitioning to a classroom which is a 1:1 technology based learning environment. Three main adaptations were found, in the areas of digital preparation, role of the digital teacher and 21st Century learning.

5.2.1 Digital preparation

Throughout the research, the underlying theme of planning in its various forms became a strong theme which was highlighted within each of the data collection techniques. This underlying theme was examined through literature where, as identified by Professor John Hattie, the teacher exerts the greatest influence on student learning. Therefore, when placed within a 1:1 technology based learning environment the teacher must develop their pedagogy through planning authentic learning experiences for students utilising the devices available (ACER, 2003). As discussed by Severin and Capota (2011), through the implementation of 1:1 devices it is thought that schools are providing their students with a higher quality education. However, if the teacher does not plan for the use of the devices within the classroom they are limiting the potential positive effect the devices can have on students' education.

This literature aligns with the themes that emerged from the participant teacher interviews in relation to the teacher's pedagogical adaptations where the highest frequency theme coded was *planning undertaken by the teacher/institution,* with 261 codings and *usage of the device,* with 226 codings. Both of these themes encompass the extensive planning undertaken by the teacher in order to integrate computing devices effectively into classroom routines and activities. This type of planning, renamed digital preparation, for example more extensive research by the teacher, including locating relevant and credible websites, and downloading, analysing and exploring applications. This extensive process determines if the selected resource is suited to address the intended learning outcomes of the lesson. Another aspect of digital preparation as discussed by Teacher 5, was ensuring that a backup plan was in place in case of unforeseen circumstances, for example power outage, internet connection interruptions or software issues and/ or students coming to class without a device (T5, 609-618).

"We also then got to have a backup plan if the power goes out or the network goes down, um in my audio design class the new hardware and software weren't communicating so I had to have other plans for the kids to carry on with while I fixed those issues." (T5, 609-918).

"I would have thought you would say oh if you haven't got your iPad you haven't got your iPad, you're trying to kind of implement a new thing for a whole class to learn and two perhaps on average one or two children they haven't got their iPads or haven't got it charged it kind of you know 'oh right okay so and the it's kind of grab your book out and see what you can do' so that to me is the biggest challenge." (T3, 414-427).

This extensive digital preparation was not only undertaken by teachers at a classroom level, but was also reflected within policy documents at an institutional level through the *outline of appropriate uses of the device.* All seven schools set out the appropriate use of the devices including damage and replacement of them. This included outlining the expectations of students and other stakeholders when the device is in the home environment as part of the ICT/device agreement or similar, and consequences of any damage that occurs to the devices,

"By accepting the agreement, the parent and student agrees to accept responsibility to pay the school $150 in the event that the iPad is lost, stolen or damaged, through that student's own negligence."(School B).

The overall purpose and digital preparation at an institutional level was also demonstrated through their *rationales for implementation* where schools justified to stakeholders the introduction of 1:1 technology program. Six of the seven participant schools made reference to key educational documents such as the Australian Curriculum and Melbourne Declaration in addition to their own approach and explicitly valued technology to justify their reasons for implementing such a program (ACARA, 2014; MCEETYA, 2008).

> *"In the Australian Curriculum, students develop ICT capability as they learn to use ICT effectively and appropriately to access, create and communicate information and ideas, solve problems and work collaboratively in all areas at school and in their lives beyond school."* (School A).

This was an important link that schools needed to make to justify the implementation of 1:1 devices, particularly if they were seeking a monetary contribution towards the cost from parents.

Another feature of institutional level digital preparation for 1:1 devices included consideration by the school of what teaching and learning might look like with the devices. This policy document feature, *outline of teaching staff integration of devices,* encompasses the expected level of usage within the classroom and has a strong connection to the interview theme *teacher's feelings towards the device*, which had 94 codings. Many schools implemented expectations of usage including the introduction of teaching models such as the SAMR model for pedagogy:

> *"This new technology has transformed our pedagogy to suit a new learning environment that's more collaborative, student-centred and project-driven. SAMR is a model designed to help educators integrate technology into teaching and learning and was developed by Dr. Ruben Puentedura. The model aims to enable teachers to design, develop, and integrate digital learning experiences that utilize technology to transform learning experiences to lead to high levels of achievement for students."*(School D).

Only two of the seven participant schools included a statement which described to stakeholders the type of integration students would be engaging with at school. This was significant because each school had justified implementing a 1:1 program and outlined the appropriate use of the devices in terms of student safety. However, they had not outlined to stakeholders/teachers the types of activities students would be using their devices to complete.

For teachers to move past substitution level integration, they must maintain a positive attitude towards the devices focused on student development and the affordances of the devices (Gibson, 1979 as cited in Webb, 2012, p. 707). The data collection showed all participant teachers were excited about the opportunity to utilise devices in their classrooms, but it was evident that not all teachers at the school were positive about the idea of teaching with the devices in the future. Teacher 3 characterised the overall staff attitude towards the devices by saying many teachers at the school held the *"gee, I'm glad it's them and not us"* view expressing that they were relieved that their class was not selected for the program (T3, 167-169). Although some of the teachers interviewed stated they were nervous or apprehensive about the inclusion of the devices in their classroom, they also remained open minded, were willing to learn, to use the

devices and approach the year with a positive attitude focusing on the possibilities of using the devices to enhance their teaching (T2, 109-116). This approach to the devices in the classroom links back to the amount of preparation and planning time teachers put into activities, which can be directly linked to their attitude towards using the devices in the classroom. It is evident that teachers who had a positive attitude towards the device continually utilized it in the classroom and took the time to plan and find applications which ensured that they progressed from substitution type activities to more student centred inquiry based learning.

The underlying theme of digital preparation emerged as a key pedagogical adaptation on both a teacher and institutional level from the research conducted. This highlighted the importance of teachers spending time researching and analysing applications and websites that are suitable for students and which will assist them to achieve the intended learning outcomes, hence the theme digital preparation. This willingness stems from the teacher's positive attitude through embracing the use of the device and its capabilities when used by students.

5.2.2 Role of the digital teacher

As discussed in chapter 2, there has been little research conducted into the role of the digital teacher in terms of pedagogical adaptations made when working within a 1:1 technology based learning environment. The term digital teacher refers to those teacher who actively utilise the technology available through the 1:1 program where every students in their corresponding class has a device. In this area there has been the development of teaching guides such as the SAMR model which provides a framework for teachers in classrooms with 1:1 devices. As discussed in the literature review there is a possible shift in role from the traditional direct instructional teacher to more of a facilitator role, where the classroom becomes a student

centred, inquiry based learning environment (Corn, Tagsold & Patell, 2011; Dunleavy, Dexter & Heinecket, 2007; Keane, Lang & Pilgrim, 2012).

To effectively implement 1:1 devices in the classroom, teachers must make pedagogical adaptations characterised by *development of teaching practices with the device*, a theme with 104 codings in the interviews. Where many teachers expressed that they had not had many opportunity to personally learn about teaching with technology in a 1:1 environment. It is vital that teachers have the opportunity to develop a range of teaching approaches to integrate the devices into the classroom program. To do this, participant teachers' highlighted opportunities such as professional development and teacher support meetings within schools to discuss their teaching practices with the devices. Within their schools, many teachers commented on the increased support between colleagues who were in these environments with Teacher 2 stating:

> *"We (teachers) communicate a lot more and we share a lot more of our ideas about how we use the technology than any other area of the curriculum." (*T2, 1057-1063).

This sharing included scenarios as discussed by Teacher 1 where teachers in the school observed each other's teaching in addition to being strongly encouraged to try new approaches to teaching and learning through the inclusion of the devices (T1, 1334-1353). Teacher 4 also discussed how the teachers within the program had access to a shared document where they uploaded resources and information regarding teaching with the devices to support each other's development of pedagogy (T4, 67-74). However, it was also evident that teachers within these programs highlighted the need for more opportunities to engage in professional

development focused in a 1:1 learning environment as an effective way to further develop their teaching practices.

> *"What support was given to us to do that, none, other than um that the children had their iPads and we had a technology aide very close to us and who is situated in our building in our block so that's very handy. But what was given to me prior to taking it on - nothing."* (T2, 120-129).

Teachers have had to independently research to develop their teaching practices in addition to collaborating with other teachers in their school who are also in the program. As discussed by Teacher 2, this is a particularly challenging process where teachers spend time evaluating applications because they must be assessed on their content and ability to assist students to meet intended learning outcomes, not just their entertainment value;

> *"Knowing how to - it's that blend between engagement and being worthwhile that's from an educational point of view, but that's a challenge - finding apps that do that"* (T2, 480-485).

Not only was the use of programs or applications highlighted by the teacher, but also type of usage strategies. For example, collaborative learning where students use the devices individually, but also learn from each other. This type of blending between new and old routines takes time for the teacher to develop the skills to manage in a non-traditional classroom. This was evident in Teacher 3's classroom, where they described the use of the device to share work

on the television in their room. Through this experience, students gave feedback to their peers with the student sharing this obtained feedback and identifying the areas of improvement in their work as a result of this collaboration (T3, 574-593). Although a confronting task, this collaborative learning develops critical analysis skills in addition to providing constructive feedback in a positive way. Many teachers described lessons which incorporated a shift to student centred and more collaborative student driven activity. After the initial direct instruction phase where the teacher outlines the lesson, students then took over, working collaboratively and independently on tasks where they have access to a wide range of information at their fingertips. In this second phase of the lesson, the teacher adopted more of a facilitator role through focusing on behaviour management and assisting students when required. This was evident through comments from Teacher 4: "*yes I feel I'm more of the facilitator of learning rather than the fountain of all knowledge*" which acknowledged the shift in role as a result of the implementation of the devices (T4, 575-578).

It is evident that with the introduction of devices into schools, both students and parents have greater access to methods of communication with teachers outside of school hours. This *connection/communication between students, parents and school through online environments* means that not only do students shift the way they operate outside of class, but teachers hours shift because they are readily contactable outside school hours. In the policy document analysis, three of seven schools made reference to this greater connection and extension of hours that teachers are contactable. They outlined the appropriate methods of communication that should be used. For example, through a school online portal, parents at School C can view their student's online submissions and homework schedules. However, it can be assumed that as parents, students and teachers become more familiar with the use of devices,

restrictions may be placed on the responding hours of teachers via digital communication methods.

For teachers to implement the devices into classroom routines and have the ability to try a wide range of pedagogical approaches, they need to take into consideration the *student attitude towards the device,* which had 29 codings. Although this theme obtained a significantly lower code frequency in comparison to other themes, if students do not value and are not motivated or engaged by the use of the device in the classroom, teachers cannot utilise new approaches to teaching. This is evident from Teacher 9 who discussed students getting bored with the device and in turn failing to charge them or bring them to class, which creates a problem when the teacher has planned an activity or lesson where students require a device (T9, 1315-1320). Teacher 9 has also found this negative attitude towards the device can mean students no longer take care of the device:

> *"I had a student the other day who was on his slate; and he was doing something when it was on the table. He moved and knocked it off onto the floor. They just, they don't think about what they're doing. I've seen them trod on when they've put them on the floor…."* (T9, 2680-2689).

In contrast, many other teachers commented on the fact that whenever the device was used, students instantly became more engaged and motivated to work, demonstrating that they value being able to use this particular device in the classroom (T4, 320-324).

It can be concluded that significant pedagogical adaptations are made in terms of the teacher's role to integrate the devices into the classroom. The role of the teacher adapts to the

more student centred nature of the classroom from a direct instruction model when outlining the task during the introduction of the lesson, and then shifts to a facilitator role where students are collaboratively and independently working where the teacher provides assistance. This is also evident beyond the classroom, where the students are able to contact the teacher outside school hours to discuss work they are completing at home. However, it is evident that professional development and teacher willingness to use the device in the classroom strongly influence the role the teacher adopts, with some teachers reluctant to take on the facilitator pedagogical style.

5.2.3 21st Century Learning

In today's technology-driven society the Australian Curriculum and Melbourne Declaration have highlighted the importance of students developing the knowledge and skills required to effectively contribute to a continuously changing, technology-rich society (ACARA, 2014; Bate, MacNish & Males, 2012; MCEETYA, 2008). Therefore, it can be assumed that teachers need to have an *understanding of the future educational needs of students,* (172 codes) through the identification of the types of knowledge and skills they will require to contribute to future society. Students in today's society not only require physical skills to operate a wide range of devices and programs, but also the ability to critically analyse digital documents for their integrity and reliability. This view strongly held by Teacher 2 who discussed wanting to teach students not only to evaluate what they are doing and viewing, but also understand the features of the device/program they require to complete a task:

> *"... it's as limiting as I guess as saying we're only going to limit them to using a pen, when there are so many other ways of putting a mark on a piece of paper you know. So I want them to look at using any device for the same ends so um that's why I was really encouraging the Google accounts because they can do it on their phone, they can do it on their iPod, they can do it…. I really believe that's, that's what they need to learn and it shouldn't be um limited to a particular device…"* (T2, 793-829).

This development of 21st century skills is also to be measured through *student engagement/progress with the device*, (25 codings). Although this theme obtained a low code frequency, it was evident the engagement of students was taken into consideration when selecting and researching apps in addition to planning learning activities. This theme also links to the students feeling comfortable and competent using the device which was a contributing reason as to why many schools selected the iPad as their 1:1 device. As discussed by Teacher 6, the iPads are very instinctive to use, which meant students didn't have to spend a large amount of time learning the how to operate the device (T6, 105-110). Therefore, using the device in the classroom occurred at a relatively faster pace in comparison to if students had to learn about the features of the device more extensively. This allowed teachers to plan to use more complex tasks utilising 21st century skills which were more engaging and motivating for students, allowing them to work independently and in collaboration with others.

5.3 Triangulation of Research Question 1

In summary there are three major pedagogical adaptations that need to be considered by teachers when operating with 1:1 technology based learning environments.

1. The first pedagogical adaptation refers to the extensive digital preparation and research that must be conducted by the teacher in the form of locating applications, credible websites and effectively routines within the classroom. This planning also encompasses contingency planning where teachers may encounter students without devices, power outages, network connection issues and crashing of applications.
2. The second pedagogical adaptation, role of the digital teacher, requires teachers to consider and revise their role in the classroom. Teachers noted that they felt as though they utilised direct instruction at the beginning of the lesson to set up the activity. They then adopted a facilitator role during the lesson and the learning became more independent, student centred or collaborative depending on the task.
3. The final pedagogical adaptation involved consideration of the future education needs of students in terms of the knowledge and skills they will require to participate within 21st century society. This entailed inclusion of activities that allow students to engage and develop these 21st century skills through the use of the devices.

5.4 Research Question 2

The aim of this research question is to identify the most effective pedagogical adaptation out of the three adaptations identified by RQ1. Through discovering which pedagogical adaptation is most effective, the researcher acknowledges the key considerations teachers need to make to integrate 1:1 devices into their classroom environment. The most

effective pedagogical adaptation must fulfil the overall goals for implementation as identified by school 1:1 policies. Therefore, as an underpinning theme of all the pedagogical adaptations identified, digital preparation is considered to be the most effective adaptation. This is because the more extensive the planning by the teacher and school around integration of the devices, expected usage in classrooms, development of student 21st century skills and for a variety of uses in the classrooms, the more students achieve positive educational experiences from using these devices.

Planning at an institutional level is evident through policy documents, where for a 1:1 program to be effective, schools must outline the *feature of ownership* over the device. This featured in five out of seven school policies. These schools explicitly stated within policy documents the ownership of the device; whether it was student owner (funded by parents), school owned or a combination of both, and how this affected student usage and ability to access and store work on the device.

> *"The school retains ownership of the Tablet until all payments have been received. At this time ownership of the Tablet will be transferred to the parent/carer"* (School C).

As demonstrated by School C, students have the device on loan from the school until the device has been paid for, as an addition to the student's school fees. However, even though until the final payment has been made the school owns the device, students are given the device to treat as their own with the school stating that the device must be brought to school every day, fully charged.

A major aspect of planning for 1:1 devices is the progression of the *development of technology literate skills*. This theme obtained a total code frequency of 145 and for participant teachers was a major priority in terms of their digital preparation. Teachers not only considered the content students engaged with, but also their use of the device in terms of their current ability to produce work and the developmental progression of technology literate skills as planned by the teacher. For example Teacher 2 described the progression of technology literate skills when referring to the array of applications students were constantly utilising to complete classroom activities.

> *"When I first started I would say yeah okay you can use whatever app you like, but I've found that they were just using the same app all the time cause the themselves were only comfortable with one app so then when I found out about now I now insist 'now you have to use this app' alright because it's for a particular reason it does something different,"* (T2, 1108-1121).

Therefore, not only does the teacher plan for the content and activities, but it can also be necessary for them to research suitable applications for students that will assist them in reaching the prescribed learning outcomes. The additional time taken to plan can be linked to the ACOT1 study where teachers felt as though they found themselves facing problems more common with less experienced teachers (Dwyer, Ringstaff & Sandholtz, 1990).

Schools must also take into consideration in their planning the *greater connection with students through the device* which received a total code frequency of 61. Schools in addition to teachers need to be explicit with students and parents the appropriate modes of communication

through avenues such as email and online learning environments. During the interview process Teacher 5 described students expecting the teacher to respond instantly to emails and postings particularly over the weekend, which was a point of frustration for teachers.

> *"....informally I've always worked late nights and weekends um but now there's a greater expectation by the kids that we're available um so that demand has certainly crept in and most teachers would work long hours, would work late nights um but the kids would never have 10 years ago expected to have me on the end of an email at 11 o'clock at night."* (T5, 657-669).

Success criteria were relatively insignificant in terms of participant schools, with only one out of seven schools outlining this feature in their policy documents through highlighting to teachers and stakeholders the expected integration of the 1:1 devices. This is particularly significant because outlining success criteria in planning for the successful implementation of the devices in the classroom, are vital for teachers to know in terms of the overall aims of the program and usage in the classroom. It also demonstrates to stakeholders that the school has thought about the future goals they want to reach through the introduction of devices, and outlines the expectation for integration by teachers for parents to view.

5.5 Triangulation of Research Question 2

In summary the most effective pedagogical adaptation is digital preparation undertaken at all levels, from the institution-wide planning to teacher classroom planning.

However, it is essential to consider planning at a content level in addition to a device level through student's development of technology literate skills.

5.6 Research Question 3

The aim of RQ3 was to uncover how dependent the outlined pedagogical adaptations from research questions one and two were in relation to the prescribed curriculum and accountability process. This encompasses re-examining the identified themes from the previous research questions, considering the themes from participant interviews and formal agreements between stakeholders in relation to students' use of devices.

In relation to the previous two research questions, digital preparation has emerged as the most effective pedagogical adaptation teachers need to make in order to teach within a 1:1 technology based learning environment. Digital preparation should not only be undertaken at a classroom or teacher level, but is also essential for institutions to complete prior to the introduction of 1:1 device. In addition to this there must be ongoing planning once devices have been introduced. This is due to much of the digital preparation process being *institutional controlled* which during the teacher interviews recorded a total code frequency of 187. This indicates that the majority of decisions about the implementation of the 1:1 devices is controlled at an institutional level. Therefore, much of the accountability in terms of *expectations of stakeholders* with a relatively low code frequency of 32, is related to the planning completed at an institutional level.

To meet these expectations of stakeholders in addition to distributing the accountability over each stakeholder, six of the seven participating schools included *policy agreements* or *agreements with institutions* code frequency of 52 which required the signature of

teacher, student and parent/guardian to sign. These agreements are put in place for institutions to exert *control of student activity with the device (*code frequency of 60) and plan for the appropriate use of the devices, while also outlining the consequences if the agreement is breached. Due to this amount of overall control and the nature of the teaching profession on a day-to-day basis, the teacher carries the weight of accountability in terms of their ability to plan content that utilises the devices beyond the substitution level.

5.6.1 Accountability

This demonstrates that schools and teachers have acknowledged and planned for their accountability in terms of the appropriate use of the devices. They have put in place measures that are designed to discourage students from using the devices in a negative, non-educational way. This was outlined by schools and exemplified by Teacher 1 who said the preventative measure put in place at the school had resulted in very few issues with the devices and little inappropriate usage (T1, 1041-1049). Teacher 1 also discussed how the school had been proactive in their approach, putting in place the agreements with students and their parents/guardians, and at the beginning of the year having all students participate in a cyber-safety program (T1, 1051-1069).

5.6.2 Prescribed Curriculum

In terms of the curriculum, as previously discussed, the majority of schools implemented their 1:1 programs in response to the requirements of the Australian Curriculum in addition to the nature of today's society (ACARA, 2014). It is also a *parent expectation,* code frequency of 60, that at school students will learn how to utilise technology to complete tasks,

problem solve and learn the basics in terms of word processing in order to be equipped with the skills they will require later in life. These expectations are also reflected in the Australian Curriculum within the general capability of Information and Communication Technology (ACARA, 2014).

5.7 Triangulation of Research Question 3

It can be seen that the most effective pedagogical adaptation of digital preparation is dependent upon and linked to the prescribed curriculum and accountability process. This highlights the need for institutions to plan across the whole school for implementation of 1:1 devices to ensure the appropriate use of the devices. Planning also relates to the prescribed curriculum to justify the reasons for implementation and ability to provide opportunities for students to engage in 21st century society.

5.8 Conclusion

As discussed in this chapter, three pedagogical adaptations of digital preparation, role of the digital teacher and 21st century learning have been identified as key for teachers working within 1:1 technology based learning environments. Overall, digital preparation, which underpins all adaptations has been identified as the most effective pedagogical adaptation at both the teacher and institutional level and it has in turn been determined that these adaptations are dependent upon the prescribed curriculum and accountability processes.

The final chapter will describe what these pedagogical adaptations in 1:1 technology based learning environments mean for institutions, teachers and students.

Chapter 6. Conclusion

6.1 Introduction

This research project identified three key pedagogical adaptations for 1:1 classrooms, with digital preparation being the most effective. To conclude this study the researcher then considered the validity and generalisability of the findings; what it means for teachers, institutions and parents; and what further research can be undertaken in this area.

6.2 Validity

6.2.1 Internal Validity

The internal validity of this project was maintained by catering for selection bias and experimenter bias. This was completed through a comparison of the selected sample to Tasmanian averages for teachers based on gender and school ICSEA value in addition to the researcher allowing an independent reviewer to code an interview transcript to test for experimenter bias. During this process the researcher allowed the independent reviewer to complete the task in an isolated way with the researcher only showing the reviewer how to use the coding program Ethnograph.

6.2.1.1 Experimenter Bias

As a result of the reviewer's first attempt at coding, 60% of codes were consistent with the researcher's. However, after discussing the coding process it was determined that the independent reviewer had interpreted some of the code definitions differently to the researcher, which caused inconsistencies. In addition to this, the reviewer believed they were not familiar enough with the code book in comparison to the researcher, stating they were hesitant to use codes they did not fully understand. For example, the independent reviewer said they were

unclear about the code *21st century skills* and therefore, chose not use this code. They also found it difficult due to the quantity of codes, whereas because the researcher compiled the codes it was clearer for them to consider which code to use without becoming overwhelmed. This resulted in the reviewer utilising fewer codes overall than the researcher for this transcript.

After these discussions with the independent reviewer it was concluded that around 80% of the coding would be consistent with the researcher if the reviewer completed the coding processes for a second time.

6.2.1.2 Selection Bias

As demonstrated in Table 9, the overall sample of participant teachers in terms of gender was not consistent with that on average of Australian Schools. This is a result of the nature of this project and circumstances through which participants were recruited. All participants in this study were volunteers from the limited number of schools located within Northern Tasmania implementing 1:1 programs. This resulted in the researcher taking a convenience sample of schools/teachers who were willing to participate in this research. In addition to this, schools implementing 1:1 device programs in Northern Tasmania were schools within the Independent and Catholic school systems, which has resulted in their overall ICSEA values being higher than the average ICSEA value for Australian Schools.

6.2.2 External Validity

The research project was undertaken within both primary and secondary schools in Australia. The results of this research can therefore be applied to a variety of educational settings where 1:1 devices are used with students in grades three to ten. In addition to this, over

the seven participant schools, four different devices had been implemented including iPads, Window Surface Tablets, laptops and Samsung Tablets. Therefore, because of the range of teachers, wide range of student ages in each program and the variety of devices implemented the results from this project are generalisable to teachers working within 1:1 technology based learning environments in Australia. This research is also relevant to teachers at schools utilising BYOD programs where students bring their own devices to school. Application beyond Australia may be possible where the cultural context of teaching using a constructivist paradigm is similar.

The identified most effective pedagogical adaptation of digital preparation aligns with the research into 1:1 device programs sponsored by HP, Microsoft and Intel (Braue, 2014). This literature highlights the explicit that planning can make on both the roll out and success of the program in a school. This confirms the study finding that digital preparation at an institutional and teacher level is vital for the success of a 1:1 program. However, this study goes beyond this research demonstrating new knowledge through providing teachers and schools with explicit, targeted recommendations that can be implemented to improve pedagogy with 1:1 devices. They flourish where a clear idea of what the use of 1:1 technology should look like in the classroom. This also assists the school to fulfil its vision for the technology and provides teachers with guidance as to the type of pedagogy and activities they should be utilising in the classroom.

Table 9: Sample Characteristics

Teacher	School Type	ICSEA Value	Gender	Sample gender balance	Tasmania ICSEA Average	Average Gender*
1	Primary	98x	Female	Primary schools Female: 50% Male: 50%	1000	Primary schools Female: 81% Male: 19%
2	Primary	105x	Male			
3	Primary	105x	Male			
4	Primary	105x	Female			
5	Secondary	112x	Male	Secondary schools Female: 50% Male: 50%	1000	Secondary schools Female: 40% Male: 60%
6	Secondary	100x	Female			
7	Secondary	100x	Male			
8	Secondary	108x	Female			
9	Secondary	100x	Female			
10	Secondary	103x	Male			
11	Secondary	103x	Female			
12	Secondary	103x	Male			

*Value from the Australian Bureau of Statistics 2010 (http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1301.0~2012~Main%20Features~Primary%20and%20secondary%20education~105)

6.3 Recommendations

6.3.1 Teachers

As highlighted in chapter five, digital preparation has been identified as the most effective pedagogical adaptation teachers can make when working within 1:1 devices. Many of the participant teachers believed their planning, especially during the early stages of implementation, was a more extensive process than they had previously undertaken. This was a result of the research and trial process where teachers had to test applications, programs and websites before allowing students to use them during class.

In order to make this process more time efficient it is recommended that teachers utilise digital repositories to store, plan lessons and resources because of the reusability of a digital format. Schools should be encouraging the use of online learning environments or repositories such as OneNote where teachers can store and link together resources which can be easily accessed. Digital preparation is not only beneficial for individual teachers, but should be

used to share ideas and collaboratively plan with other teachers to reduce the time needed to plan for a 1:1 technology based learning environment. It is this style of digital preparation and sharing of resources that is vital to the success of a 1:1 program, where teachers are not being weighed down with the planning process.

6.3.2 Institution

At an institutional level it was evident that schools had planned for the implementation of the devices in terms of their logistics (including infrastructure), and put into place preventative measure to discourage negative use of the devices. This type of planning is essential for schools for the program to run smoothly. However, the majority of schools omitted essential features of planning; such as communicating their vision to teachers of what the 1:1 devices look like in the classroom in terms of the types of activities, teaching style and uses of the devices. This was highlighted through many of the teachers discussing that they were encouraged to use the devices in whatever way they saw fit, without any real direction from the school. It was clear that, although the participant teachers were all enthusiastic and willing to try different techniques with the devices, an explicit vision of the schools in relation to asking the key question 'what will 1:1 technology look like in our classrooms?' was lacking. Therefore, it is recommended that through answering this key question, schools provide guidance, goals and success criteria for teachers working within the 1:1 devices. It was evident that although schools had encouraged teachers to use their creativity and implement the devices in any way they wanted, they needed to more explicitly communicate their vision for the use of the technology within the student learning program.

6.3.3 Recommendation for further research

To further explore this area of 1:1 technology based learning environments in schools it is recommended that future research be focused upon the explicit planning process teachers undertake to teach within these environments. This would include exploring the most effective way of compiling and storing lesson planning and associated resources, in addition to how teachers can use digital systems to share planning ideas and resources in a collaborative manner both in their own and in other schools.

6.4 Conclusion

The overall aim of this project was to explore the types of pedagogical adaptations teachers make when working within a 1:1 technology based learning environment. This was completed through the researcher conducting interviews with Tasmanian teachers and collecting key documents from schools. These interview transcripts were then analysed through a grounded theory approach where themes emerged from the data. Interviews from the EdFutures study were also coded. It was found that the most effective pedagogical adaptation was 'digital preparation' for the implementation of 1:1 devices in the classroom. This led to the recommendation teachers utilise digital repositories for storing the planning and resources from this 'digital preparation' for use in future years and sharing with colleagues. In addition, it is recommended schools explicitly communicate to teachers what the use of the 1:1 devices should look like in classrooms. This new knowledge allows schools and teachers to focus on the worthwhile use of the devices in the classroom, and provides them with strategies to ensure they are delivering authentic learning experiences for their students.

References

Apple (2008). *ACOT2: Apple Classrooms of Tomorrow- Today*. Retrieved May, 12, 2014 from http://ali.apple.com/acot2/

Australian Council for Education Research [ACER]. (2003). *Teachers make a difference: What is the research evidence.* University of Auckland: John Hattie.

Australian Curriculum, Assessment and Reporting Authority [ACARA]. (2014). *The Australian Curriculum: Technologies v 6.0.* Retrieved: http://www.australiancurriculum.edu.au/technologies/rationale-aims/technologies

Australian Information and Communications Technology in Education Committee [aictec]. (2009). *Digital Education Revolution Implementation Roadmap.* Retrieved: http://ehlt.flinders.edu.au/education/eduwiki/lib/exe/fetch.php?media=students10:research_docs:der_implementation_roadmap.pdf

Australian Institute for Teaching and School Leadership [AITSL]. (2008). *Success through partnership: Achieving a national vision for ICT in schools: Strategic plan to guide the implementation of the Digital Education Revolution initiative and related initiatives.* Retrieved: http://www.teacherstandards.AITSL.edu.au/static/docs/hotTopics/Success_through_partnership_-_Achieving_a_national_vision_for_ICT_in_schools.pdf

Bate, F., MacNish, J., & Males, S. (2012). Understanding parent perceptions of 1:1 laptop program in Western Australia. *Australian Educational Computing, 27(2),* 18-21.

Bebell, D. & Kay, R. (2011). One to one computing: A summary of the quantitative results from the Berkshire wireless learning initiative [Electronic version]. *The Journal of Technology, Learning and Assessment, 9(2).*

Bergh, D., Hanke, R., Balkundi, P., Brown, M., & Chen, X. (2004). An assessment of research designs in strategic management research: The frequency of threats to internal validity. *Research Methodology in Strategy and Management, 1, 349-371.*

Bingimlas, K. (2009). Barriers to the successful integration of ICT in teaching and learning environment: A review of the literature [Electronic version]. *Eurasia Journal of Mathematics, Science and Technology Education, 5(3),* 235-245.

Braue, J. (2005). 1:1Computing: a guidebook to help you make the right decisions. In Gwen Solomon (ed.) *Technology & Learning*. New York, USA: CMP Media LLC.

Buchanan, R. (2011). Paradox, Promise and Public Pedagogy: Implications of the Federal Government's Digital Education Revolution. *Australian Journal of Teacher Education, 32(2), 67-78.*

Cohen, L. & Manion, L. (2000). *Research Methods in Education.* (5th e.d.). London: Routledge.

Corbin, J. & Stauss, A. (1990). Grounded Theory Research: Procedures, Canons, and Evaluative Criteria. *Qualitative Sociology, 13(1), 3-20.*

Corn, J., Tagsold, J. & Patel, R. (2010). The tech-savvy teacher: Instruction in a 1:1 learning environment [Electronic version]. *Journal of Educational Research and Practice, 1 (1),* 1-22.

Department of Education, Employment and Workplace Relations (2008). *National Secondary School Computer Fund: Round one guidelines.* Retrieved: http://docs.education.gov.au/system/files/doc/other/d13_311974_national_secondary_computer_fund_round_one_guidelines.pdf

Downes, T., Fluck, A., Gibbons, P., Leonard, R., Matthews, C., Oliver, R., Vickers, M., and Williams, M. (2001). *Making better connections: Models of teacher professional development for the integration of information and communication technology into classroom practice.* Canberra: Australian Curriculum Studies Association.

Dunleavy, M., Dexter, S., & Heinecket, W.F. (2007). What added value does a 1:1 student to laptop ratio bring to technology-supported teaching and learning? *Journal of Computer Assisted Learning, 23*, 440-452.

Dwyer, D.C., Ringstaff, C. & Sandholtz, J.H. (1990). *Apple Classrooms of Tomorrow Research: Report number 10: Teaching in High-Tech Classrooms: Classroom Management Revised: First- Fourth year findings*. Cupertino, CA: Apple Computer Inc.

Finger, G., Russell, G., Jamieson-Proctor, R. & Russell, N. (2007). *Transforming learning with ICT: Making it happen.* Frenchs Forest, NSW: Pearson Education Australia.

Fram, S.M. (2013). The constant comparative analysis method outside of grounded theory. *The Qualitative Report, 18(1), 1-25.*

Giddings, L. (2013). *Parliament of Tasmania: Budget paper no. 1: The Budget.* Retrieved: http://www.budget.tas.gov.au/

Hall, K., Murphy, P., & Soler, J. (eds) (2008). *Pedagogy and Practice: Transforming Identities*. London: Sage.

Huitt, W., Hummel, J. & Kaeck, D. (1999). *Assessment, Measure Evaluation & Research: Threats to external and internal validity.* Retrieved April 21, 2014, from: http://www.edpsycinteractive.org/topics/intro/valddv.html

Keane, T., Lang, C., & Pilgrim, C. (2012). Pedagogy! iPadology! Netbookology! Learning with mobile devices. *Australian Educational Computing, 27(2),* 29-33.

Kukulska-Hume, A., & Traxer, J. (2007) Designing for mobile and wireless learning. In Beetham, H., & Sharpe, R. (Eds) (2013). *Rethinking pedagogy for a digital age: Redesigning and delivering e-learning.* (2 ed.). New York: Routledge.

Larkin, K. & Finger, G. (2011). Netbook computers as an appropriate solution for 1:1 computer use in primary schools. *Australian Educational Computing, 26(1), 27-34.*

Lloyd, M., & Mukherjee, M. (2013). Tell me what you see: Pre-service teachers' recognition of exemplary digital pedagogy. *Australian Educational Computing, 27(3),* 85-94.

Looi, C.K., Zhang, B., Chen, W., Seow., Chia, Norris, & Soloway, E. (2011). 1:1 mobile inquiry learning experience for primary science students: A study of learning effectiveness. *Journal of Computer Assisted Learning, 27, 269-287.*

Mathison, S. (1988). Why Triangulate? *Educational Researcher, 17(2), 13-17.*

Ministerial Council on Education, Employment, Training and Youth Affairs [MCEETYA], (2008). *Melbourne declaration on educational goals for young Australians.* Retrieved: http://www.mceecdya.edu.au/verve/_resources/national_declaration_on_the_educational_goals_for_young_australians.pdf

Mishra, M. & Kohler, P. (2007). What is technological pedagogical content knowledge?. *Contemporary issues in Technology and Teacher Education, 9(1), 60-70.*

Moseley, M. (2006). *Creating recursive writing in the middle school: The effect of a writing program on student revision practices.* (Doctoral Dissertation). Available from ProQuest Dissertations and Thesis Data Base. (UMI no. 3230021).

O'Leary, Z. (2010). *The essential guide to doing your research project*. London: SAGE publications Ltd.

Pally, M.U. (2013). Creating constructivist learning environment: Role of 'web 2.0' technology. *International Forum of Teaching and Studies, 9(1), 39-50.*

Qualis Research (2014). *Ethnograph*. (Version 6.0.1.0). [Computer program]. Retrieved July, 5, 2014 from http://www.qualisresearch.com/default.htm

Reading, C. & Doyle, H. (2013). Teaching educators as leaners: Enabling learning while developing innovative practice in ICT-rich education. *Australian Educational Computing, 27 (3), 109-116.*

Redmond, P. (2011). From face-to-face teaching to online teaching: Pedagogical transitions. *Ascilite 2011: Changing demands, changing directions.* 1050-1060.

Rogers, E. (1995). *Diffusion of Innovation.* (4th e.d.). New York, NY: The Free Press.

Sangani, K. (2013). BYOD to the classroom. *Engineering & Technology, 8(3), 42-45.*

Severin, E. & Capota, C. (2011). Inter-American Development Bank. *One-to-one laptop programs in Latin America and the Caribbean: Panorama and perspectives,* No. IDB-TN-261. Retrieved: http://wiki.immuexa.com/download/attachments/8048/IDBDOCS-%2335989594-v2-One-to-One_Laptop_Programs_in_Latin_America_and_the_Caribbean_.PDF

Twining, P. (2013). *EdFutures Study*. The Open University. http://Edfutures.net.

Warburton, B. (2009). *Assessment and evaluation in higher education: Quick win or slow burn: modelling UK HE CAA uptake.* London, UK: Routledge.

Webb, M. E. (2005). Affordances of ICT learning: Implications for an integrated pedagogy. *International Journal of Science Education, 27(6), 705-735.*

White, G.K. (2013). *Digital fluency: Skills necessary for learning in the digital age.* Australian Council for Educational Research. Melbourne: ACER.

Appendix 1 – EdFutures Study Ethics Approval Letter

Social Science Ethics Officer
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Katherine.Shaw@utas.edu.au

HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

3 September 2013

Professor Peter Twining
C/- School of Education
Locked Bag 1307

Sent via email

Dear Professor Twining

Re: FULL ETHICS APPLICATION APPROVAL
Ethics Ref: **H0013438 - EdFutures Snapshot Studies**

We are pleased to advise that the Tasmania Social Sciences Human Research Ethics Committee approved the above project on 1 September 2013.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.

3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.

4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.

5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**

6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

Katherine Shaw
Ethics Officer
Tasmania Social Sciences HREC

Appendix 2 – Ethics Committee Approval Letter

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HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

5 March 2014

Dr Andrew Fluck
Faculty of Education
Locked Bag 1307

Student Researcher: Lillian Males

Sent via email

Dear Dr Fluck

Re: MINIMAL RISK ETHICS APPLICATION APPROVAL
Ethics Ref: **H0013829 - Exploring the impact of 1:1 technology based education on teachers' pedagogy**

We are pleased to advise that acting on a mandate from the Tasmania Social Sciences HREC, the Chair of the committee considered and approved the above project on 4 March 2014.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

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5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**

6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

Katherine Shaw
Executive Officer
Tasmania Social Sciences HREC

Appendix 3 - Code Book

Code	Definition
21st Century Skills	Skills linked to learning in the 21st century, whereby students engage with skills such as evaluating, critiquing and selecting the effectiveness of apps/programs for specific purposes, and evaluating, critiquing and selecting reliable sources of information based on characteristics, solving problems in different ways, demonstrating and assisting others in composing, creating and using technology.
Accountability	The expectation of teachers from a stakeholder's perspective.
Backup Planning	Activities planned in case of difficulties with technology e.g. student forgets devices, students device is not charged, power outage and internet connection difficulties.
Behaviour Management	Strategies the teacher puts in place to ensure students are engaging with relevant tasks in a sensible manner during class time.
Catering for Diversity	Ensuring that each student's diverse needs are met within the classroom in terms of academic, physical, social, mental and emotional wellbeing.
Collaborative Learning	Where students learn from each other through activities which allow them to construct their own knowledge and understanding from a variety of sources.
Differentiation	Catering for the different needs and learning styles of students.
Engagement	Strategies the teacher uses to capture the interest and attention of students
Future Planning	Teachers learning for future learning with the use of the devices.
Integration	The level of integration of the device in the everyday routines of the classroom.
Online Learning Environment	A space online where students can access content, assessment and information about their class/enrolled subject. Students can discuss/collaborate with peers through online forums/discussion boards which are monitored by the teacher. The teacher uploads relevant content and information in the form of videos, audio, links to website/readings for students to engage with.
Parent Attitude	The parent's attitude towards having the 1:1 devices in the classroom.
Professional Development	Learning opportunities undertaken by the teacher in order to further their knowledge in utilizing the devices in their classroom.

Code	**Definition**
Pedagogy	Teachers' pedagogy is explored through all facets including the four domains 'subject and curriculum knowledge, teaching repertoire of skills and techniques, teaching and learning models and conditions for learning' and 'encompasses the theory and practice of supporting other people's learning (Hall, Murphy & Soler, 2008, p. n.d.).
Planning	Teacher planning of learning activities for students to engage with.
Student Attitude	Student's perspective on having the devices to use within the classroom.
Student Outcomes	How well students gain an understanding of key concepts, in relation to content present and the relevant curriculum.
Teacher Attitude	How teachers felt about students receiving a device.
Teacher Support	Teachers/school supporting others learning and implementation of the 1:1 program.
Teacher Personal Skill	Teacher's personal skill level/competency with the implemented device.
ACOT 1	
Adaption	Through the teachers planning and implementation student become more productive in the same amount of time.
Adoption	Teacher has a better understanding of the device, however, utilizes drill and practice instruction.
Appropriation	The teacher has developed personal mastery of the device, the students devices are used throughout the daily classroom routine and become more flexible towards their teaching of the curriculum.
Entry	Teacher utilizes the principles of traditional schooling.
Invention	Technology is integrated into learning time through the planning of dynamic learning experiences.
ACOT 2	
Culture of Innovation and Creativity	Teachers are encouraged to be creative with the use of technology in their classrooms.
Relevant and Applied Curriculum	The engagement with a wider curriculum with students through the usage of the device.
Social and Emotional Connection with students	The greater connection teachers have with students through the usage of the device.

Code	**Definition**
Understanding 21st Century	The understanding schools have in relation to the skills and capabilities students require in order to be future contributors to society.
Effect of Ownership	
Positive Effect	The student utilise and care for the device as if it is their own (if purchased by the school)
Negative Effect	The students do not care for the device even if it did belong to them, this may result in them not bringing the device to school, having an uncharged device. Students overall did not mind if they used the device in class or not.
Logistics	
Infrastructure	Resources the school has implemented to ensure that the network can cope with the large number of devices, including wifi, modems, bandwidth, NBN etc.
Policy Agreement	In order to have the device students must comply with a number of guidelines in regards to charging the device, loading applications, storage etc.
Storage	Includes both storage at home and at school (may be linked to the policy agreement).
Pedagogy	
Facilitator	Where the teacher allows students to make decision for themselves in the classroom within the parameters of a task e.g. student are able to decide how they would like to present their information report through selecting an iPad or a device driven etc.
Non-Traditional Pedagogy	The teacher gives stduents task instructions; which may or may not be in a traditional format, however, students are able to explore the task themselves including researching information in a variety of formats, collaborating with peers or others in the school community, critiquing resources and extracting relevant information whereby they present the information in a variety of modes which may or may not be planned by the teacher.
Student Centred	Where tasks focus on students interest and students no only lead the topic but research information themselves.
Traditional Pedagogy	Where the teacher allows students to make decisions from the prescribed tasks as created by the teacher e.g. students are able to decide how they would like to present their information report through selecting a method planned by the teacher.
Synthesis	

Code	**Definition**
Direct Instruction Usage	The use of the devices in terms of the manner in which it used is planned and controlled by the teacher. Students are instructed at specific times to sue the device in prescribed ways.
Integration	Where devices are used throughout the day, however, the use is still planned for, but is no longer being used for substitution purposes.
Integration of online learning environments beyond the classroom	Conten and activities used are presented in both the classroom and online with students being able to engage with content outside of the classroom, in addition to participating in online polls and discussions which are located through the online learning environment. Students also submit work through this online learning environment.
Minimal Usage	The use of the device in the classroom is very little.
Online Learning Environment	Use of online learning environments in addition to the classroom, content and activities are presented through an online platform where students can access material at their leisure. Students also submit work through this online learning environment.
Seamless Assimilation in the classroom	The use of the device is planned for by the teacher however, students are free to use their devices in a spontaneous nature where there is no longer time restrictions on when they are allowed to use their devices in the classroom.
Substitution	The device is used within the classroom primarily in place of another tool e.g. instead of writing in their book they type on their device, instead of reading a physical book they utilize eBooks.
Teacher Attitude	
Positive Teacher	Teacher are excited about students receiving their own device.
Negative Teacher	Teachers were not pleased with each student receiving a personal device.

Appendix 4 – Coding density analysis of interview transcripts

Participant Teacher Interview Responses – coding density analysis

	T1	T2	T3	T4	T5	T6 & 7	T8	T9	T10, 11 & 12	Total
21st Century Skills	12	18	13	10	8	17	10	3	14	105
Non-Traditional Pedagogy	9	11	17	7	6	12	9	5	15	91
Student Centred	10	4	9	6	0	14	11	6	7	67
Planning	5	8	7	2	4	12	6	8	3	55
Professional Development	7	3	0	4	1	4	10	9	9	47
Policy Agreement	5	2	2	3	2	9	3	14	7	47
Teacher Support	3	6	0	3	0	4	8	9	11	44
Facilitator	4	0	6	5	2	7	5	7	6	42
Engagement Strategies	3	7	5	5	0	13	5	2	1	41
Positive Attitude (Teacher)	3	6	7	5	1	2	7	6	4	41
Infrastructure	9	4	3	3	2	2	0	9	8	40
Traditional Pedagogy	6	5	5	2	5	8	1	4	4	40
Behaviour Management	6	0	0	2	3	14	4	8	2	39
Other Devices	1	1	0	0	4	4	1	5	22	38
Ubiquitous access to technology	4	3	0	0	6	2	1	4	18	38
Understanding 21st Century	1	4	0	0	7	1	3	2	12	30
Direct Instruction Usage	2	2	4	3	2	7	2	4	4	30
Pedagogy	10	5	3	4	0	2	0	0	4	28
Parent Attitude	2	5	2	2	0	5	0	5	6	27
Teacher Personal Skill	3	2	3	3	0	5	4	4	2	26
Accountability	4	1	3	0	2	0	7	4	2	23
Substitution	0	0	2	1	2	5	2	4	2	21
Culture of Innovation and Creativity	13	2	1	0	0	2	1	1	0	20
Differentiation	0	2	5	3	2	2	1	0	4	19
Student Attitude	2	3	2	0	1	2	1	4	4	19
Collaborative Learning	1	0	4	3	0	4	1	1	2	16
Teacher Attitude	0	1	0	1	2	2	0	2	6	16
Integration of online learning environments beyond the classroom	0	0	0	0	7	1	0	2	4	14
Logistics	3	0	0	2	0	2	0	3	4	14
Back-up Planning	0	1	1	0	2	0	2	5	2	13

	T1	T2	T3	T4	T5	T6 & 7	T8	T9	T10, 11 & 12	Total
Negative Attitude (Teacher)	2	2	2	0	3	1	0	0	3	13
Future Planning	0	0	0	1	0	1	2	1	5	10
Student Outcomes	0	0	0	2	0	1	3	2	1	9
Online Learning Environments (S)	0	2	0	0	0	0	1	6	0	9
Online Learning Environment	0	1	0	0	5	1	0	0	1	8
Negative Effect (Ownership)	0	2	0	0	0	0	0	2	3	7
Integration (S)	1	0	0	0	0	2	1	1	1	6
Appropriation	1	1	0	0	0	0	1	1	1	5
Relevant and Applied Curriculum	2	0	0	0	0	2	0	0	1	5
Storage	0	0	0	2	0	3	0	0	0	5
Positive Effect (Ownership)	0	2	0	0	0	1	0	0	0	3
Effect of Ownership	0	1	0	0	0	0	0	0	1	2
Entry	0	0	0	0	1	0	0	0	0	1
Invention	0	0	0	0	0	1	0	0	0	1
Social and Emotional Connection with Students	0	0	1	0	0	0	0	0	0	1
Synthesis	0	0	0	0	0	0	0	0	0	0
Adaption	0	0	0	0	0	0	0	0	0	0
Adoption	0	0	0	0	0	0	0	0	0	0
Minimal Usage	0	0	0	0	0	0	0	0	0	0
Seamless Assimilation	0	0	0	0	0	0	0	0	0	0